




LIGHTING THE WAY — Luminarias, a New Mexico tradition dating back to the 16th century, light the plaza and the historic San Felipe de Neri church during the annual Old Town Stroll. This year, hundreds of people joined the holiday celebration on Dec. 7, which included the lighting of the city’s holiday tree and performances by local high school singing groups. (Photo by Randy Montoya)

Sandia’s Quality Journey



A sense of urgency and seriousness springs from the Strategic Quality Management System Team as they discuss the need to deliver by Dec. 15 the framework for an integrated quality management system to strengthen the Labs’ current approach to quality. Read the story on [pages 4-5](#).

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Nuclear weapons – the third era

After Cold War, Science-Based Stockpile Stewardship eras, Sandia will play key role in the Stockpile Modernization age

By Jerry McDowell, Deputy Labs Director and Executive Vice President for National Security Programs

For more than 60 years, the United States has relied on its stockpile of nuclear weapons to provide the ultimate strategic deterrent to adversaries who would do harm to the US and its closest allies. While the stockpile has played a profoundly important role in modern American history and US relationships with friend and foes alike, the story of its development and maintenance has not been written in one uninterrupted chapter. In fact, we are now entering the third era of the US nuclear weapon enterprise, an era that will see Sandia assume an increasingly pivotal role in sustaining the nation’s nuclear deterrent. The US launched the nuclear age in the 1940s when it embarked on an all-out effort to create a weapon that could abruptly and decisively win World War II. While the aims of the Manhattan Project were realized in dramatic fashion and with stunning finality at Hiroshima and Nagasaki, the nuclear weapon age was not at an end. In fact, it was just beginning. The Soviet Union, emerging from World War II as a global superpower underpinned by an ideology inimical to the US, soon acquired nuclear weapons of its own. The conflicting goals and world views of the two dominant postwar powers led — some say inevitably — to the Cold War, the first nuclear weapons era. In that era, characterized by a relentless arms race, the dynamics of the Cold War propelled the development of a seemingly ever-expanding nuclear stockpile. A key design imperative was to maximize warhead yield or explosive output while minimizing weight and



THE NATION is now in the third era of the nuclear weapon enterprise, says Deputy Labs Director for National Security Programs and Executive VP Jerry McDowell. In this Stockpile Modernization era, Sandia will play a pivotal role. (Photo by Randy Montoya)

volume, and the US nuclear weapons program was continuously working to anticipate and exceed the pace of Soviet development. This was an era of small-margin (Continued on page 12)

Kauai Test Facility marks 50 years of success

See stories and photos beginning on page 7

That’s that

Well, that was easy. For me, I mean.

Our group just went through the trials, tribulations, testiness, and traumas of moving our entire operation lock, stock, barrel, and modern electronic appurtenances from our purpose-built home of 17 years in Bldg. 811 to a suite of offices in IPOC. The new space is perfectly satisfactory, but I think I’ll miss being closer to the front door of the Labs, so to speak. Everyone I’ve talked to at IPOC says that not only will we get used to it, we’ll end up loving it. No dealing with getting on the base every morning. Stuff like that. Thing is, I *liked* being on the base.

I definitely leave Bldg. 811 with mixed feelings. It’s been my home almost since I started at Sandia. I made lifelong friends in Bldg. 811, built a career I’m proud of in that building, and did some work there that I believe has served the Laboratories and the nation very well. You don’t just walk away from that with no looking back.

But life goes on, Indy, and in the big scheme of things, it’s hard to argue with the decision to move us. The driver for the change, as I understand it, is the need to make room for an anticipated influx of new hires to support our primary nuclear weapon mission. So that’s a good thing. While Bldg. 811 was just outside the tech area during our tenure, the intention is to extend the fence around the building before the new folks move in.

In any event, the move went swimmingly for me, thanks to the tireless efforts of our incomparable OAA, Michelle Fleming. She is a one-woman dynamo who took command of this entire process and managed every detail like a field general. Watching this process unfold made me grateful that we have the kind of support Michelle provides.

I’d like to say, too, that the teams that did the actual moving for us – the CSU Move Team and the Facilities Move Team – were just terrific. Everything happened on schedule, exactly when they said it would. They did the heavy lifting and I admit to being at an age when I really appreciate that.

* * *

This is the last issue of the *Lab News* of 2012 and, by some calculations, maybe the last issue ever. Now, don’t get the wrong idea. We have every intention of continuing to publish but there are folks out there – more than a few – who are convinced that the world is going to end on Dec. 21, 2012, when a 5,125-year cycle known as the Long Count in the Mayan calendar comes to a close. When that cycle ends, the believers say, it’s happy trails to you.

The doomsday phenomenon is global. Here’s the lead sentence from a recent *New York Times* story: “There are scattered reports of unusual behavior from across Russia’s nine time zones.” The story then goes on to cite various cases of mass hysteria across the vast country. The situation has apparently gotten so bad that Russia’s minister of emergency situations took the unusual step of issuing an official rebuttal. Citing “methods of monitoring what is occurring on the planet Earth,” he said he could state with confidence that the world was not going to end in December.

But Russians aren’t the only people preparing for the end. As I said, the phenomenon is global, so widespread that there is even an “official” 2012 doomsday website with an “official” countdown clock, and an online store to buy “official” 2012 stuff. All very official.

I’m a skeptic by nature but when it comes to the end of the world – I see it as the ultimate low-probability, high consequence event, after all – I do admit to having just a teeny, tiny twinge of disquiet. What if ? Nah. But, what if . . . ?

My mind was put somewhat at ease about all of this when one of my colleagues recounted a recent family conversation. Seems her uncles were talking about this and that on the phone. Her aunt, overhearing just one side of the conversation, thought the subject sounded a bit odd. In her thick southern accent, she says to uncle No. 1: “What’re y’all talking about?” “The end of the world,” he says.

“Whaaat?!?!”

“You know,” he replies patiently, “that Mayan calendar thing that’s predicting the end of the world on December 21.”

“Oh, yeah, *that*,” she says dismissively. “Well, that don’t matter to *us*, honey. We ain’t Mayan.”

She’s got a point there.

And with that, I wish us one and all a very happy holiday season. If we’re around celebrate it, that is. That Mayan thing, you know.

See you next time.

Bill Murphy (505-845-0845, MS1468, wtmurph@sandia.gov)



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Feedback

Readers asked . . .

Can Shipping and Receiving use better technology for package tracking?

* * *

Can Eubank gate be made safer for cyclists?

Q: It seems like packages and deliveries are frequently lost here at Sandia. Not a week goes by that I don't get an email saying "a package was delivered — did anyone in the building by chance get it?" This has been true of the other building I sat in also. Would Sandia consider investing in technology to prevent lost shipments? Perhaps putting bar codes on every office that can be scanned along with a package when it is delivered? This should enable the shipping dept. to tell anyone exactly where a package was delivered and when.

A: Thank you for your inquiry. The receiving process at Sandia/New Mexico begins in Bldg. 957. On average 1,300 packages are received and delivered daily, handled by a staff of approximately eight individuals. These individuals are responsible for delivery to all Sandia/New Mexico locations.

In reviewing the inquiry, we have identified three major points.

• Point 1: Why are lost package emails sent to buildings? The use of bar codes on packages and bar codes on the buildings is the first step to confirming delivery location of the lost packages. Sending emails to all building occupants is the last step in an internal process of locating lost packages. Several steps are taken internally to resolve the issue of lost packages prior to sending the email notification for assistance. This is the final step in locating a lost package within a building. The email notification to residents is asking for assistance in locating the lost package. In investigations of lost packages, it has been determined that packages are correctly delivered; however, the lost package was actually picked up, or moved to a different location by another building resident.

• Point 2: Why don't we use technology to prevent lost shipments? We currently use handheld scanners capable of scanning the bar codes affixed to the packages we deliver. This is a proven technology that we have been using for more than 10 years. Currently, Logistics is looking at an alternate means of tracking packages as they arrive and are delivered. We are looking at alternative technologies and methodologies for future state of operations, but due to budget constraints we are limited to any technological upgrades at this time.

• Point 3: Why don't we have barcodes on every door? In years past, barcodes had been placed on every door. However, due to the frequency of employee moves and employees' having multiple locations — such as labs and offices — it was determined that constant updating and changes of labels became labor-intensive and this methodology was discontinued. Currently, we rely on Oracle and SAPLE as our location tracking tool. This is the most up-to-date information we have, and addresses are based on that information. Currently, all buildings have a barcode that we use daily to track delivery of packages. This allows us to verify the package was delivered to the correct building location. Packages are typically delivered to the person on the address label, which provides us with a reliable tracking mechanism.

— Joe Costales, manager, Shipping, Packaging, Storage, Mail Dept. 10261

* * *

Q: I am a bicycle commuter and I have recently had a few close calls while exiting the Eubank gate. Typically I leave between 5:30 and 6:30 p.m. and the state of the exit gates at the Eubank gate are configured in different ways. The most concerning to bicycles is the configuration where the far right pedestrian/bicycle gate and the right vehicle gate are closed. This configuration causes bicycle commuters to navigate through the 20th Street curve west of the gates and then having to merge into vehicle traffic to exit the base. If at all possible, could the traffic safety SME weigh in with the KAFB security forces to keep the pedestrian/bicycle gate open at least until 7 p.m.? This would make for a much safer commute for all.

A: Thank you for submitting this feedback comment. This concern will be taken to the Base Traffic Working Group for discussion. Bicyclists are encouraged to utilize the IPOC Gate to enter and exit KAFB. The IPOC gate places the bicyclists directly onto the south end of Eubank Boulevard, where there is less traffic. From the IPOC gate the bicyclists can either take Eubank north or Innovation east. The IPOC gate is a much safer location in that it avoids the Eubank KAFB gate altogether.

— Jeremy Michaels, Infrastructure Dept. 4821

Legacy hardware removed from Bldg. 927

By Patti Koning

You think cleaning out your garage is hard? Try emptying a building of a hodgepodge of legacy nuclear weapons hardware, some of it decades old, and other pieces developmental and poorly characterized.

Since 2003, there have been a number of attempts to clean out Bldg. 927. Each attempt was derailed for various reasons — lack of funding, management changes, or priority shifts. But fiscal year 2012 was different, as Bldg. 927 is now slated to be incorporated into the Livermore Valley Open Campus. The elements of success came together — executive support, funding, and dedicated staff.

The legacy hardware removal from Bldg. 927 was made a Performance-Based Incentive (PBI) in the contract with the Sandia Site Office that went all the way up to VP of Infrastructure Operations Mike Hazen (4000). The project received \$400,000 in funding with a fiscal year-end deadline.

In September, the Legacy Hardware Removal team, led by Larry Carrillo (8247), successfully characterized and dispositioned 27 distinct items. Deborah Linnell and Steve Costa (both 8257) served as the technical leads and Nydia Brazeau (8248) was the project manager. Other team members are Leroy Duran (4144), Janet Harris (8516), Jeff Jarry (4144), Barbara Larsen (8516), Mike Moore (4144), Mike Norte (4020), Al Sandoval (8516), Laura Tidwell (8516), and Shannon Yeoman (8531).

For some perspective on the significance of this accomplish, you only need to consider Deborah — she put her retirement on hold to see the project through to the finish. “I was involved with a broader site cleanup in 2003 and first heard about the special legacy hardware in Bldg. 927 in 2005. It was renamed as a storage reduction project in 2006 and we made a lot of progress, but not in 927. Then it came back in 2008,” she says. “I was going to think seriously about retiring in 2011, but we were so close I didn’t want to leave until it was finished.”

Nydia credits the success of the project with teamwork. “We had limited funding, a tight deadline, and a very complicated project,” she says. “We encountered a lot of obstacles, but worked through those together.”

Plan A for the project was to send the hardware to the Nevada National Security Site (NNSS) for disposition. Early in the year, the team realized that classification, environmental, and logistic issues negated a direct transfer. These issues also killed Plan B, to ship the hardware to New Mexico.

The team then had to look at each item individually



THE LEGACY HARDWARE REMOVAL TEAM relaxes on the loading dock of Bldg. 927. From left to right, standing on stairs: Nydia Brazeau, Shannon Yeoman, Janet Harris, Albert Sandoval, Barbara Larsen, Deborah Linnell; in front are Larry Carrillo and Steve Costa (seated). Laura Tidwell, Leroy Duran, Jeffrey Jarry, Mike Moore, and Michael Norte are not pictured. (Photo by Dino Vournas)

to identify its proper path. In some cases, this meant trying to figure out exactly what they were looking at. “Some of the hardware was from weapons that were designed back in the 1950s, for which there were no drawings or the drawings that existed were very cryptic,” says Nydia. “For a couple of items, the description was not specific enough for us to determine how to classify the material.”

The team encountered hurdle after hurdle, first with identifying DOE and NNSA vendors and working through logistical issues. “One item contained lithium, and we were paying by the pound, so that one item blew the budget,” she says. “Another vendor could accept some of our material but they had a short window of time because of another impending project.”

The team was able to secure an additional \$200,000 in funding to deal with the higher-than-expected costs of beryllium and lithium treatment.

Trying to comply with federal, state, and county regulations along with Sandia’s own corporate policies increased the complexity exponentially. “We were looking at this from five or six different angles and try-

ing to cover all of our bases. It was intense,” says Steve. “To be able to pull this together in a short amount of time was kind of exciting. Even though we had a lot of challenges, it was also fun because of the way the team communicated and everyone’s dedication to seeing this project through.”

Of the 27 items identified for removal from the California site, nine were handled internally, either through disposal or transfer. Two others were transferred to Lawrence Livermore National Laboratory and the remaining 16 were successfully packaged and shipped for treatment.

Nearly 2,800 square feet of space was released from Bldg. 927 for use in the Livermore Valley Open Campus. Bldg. 923 was identified as a new storage site for wanted items from Bldg. 927.

Sandia *CaliforniaNews*

Will clouds save us from climate change?

By Patti Koning

Will clouds save us from climate change? In short, no, according to Texas A&M professor Andrew Dessler. In a distinguished lecture on Nov. 11, he discussed his research on cloud feedbacks and how those results help answer that question.

“When it comes to climate change, everyone wants to ask the question, ‘Is the climate changing?’ It’s really not a very interesting question because we all know the answer — yes,” he said. He explained how the different ways of measuring climate change, such as surface thermometer measurements and sea-level rise, all come together like a jigsaw puzzle.

While climate change is widely recognized as a real and growing threat to the environment, some climate change skeptics have now embraced the idea that it doesn’t matter because clouds will respond like an automatic thermostat and counter future temperature increases. Clouds have a cooling effect on the planet by reflecting incoming solar radiation back to space. But some clouds also warm the climate by absorbing infrared radiation, essentially trapping heat in the Earth’s atmosphere.

“The net effects of clouds are the difference between these two effects — they are two large, offsetting terms and it is really a bear of a problem,” said Dessler. “The question is, how do clouds perturb the Earth’s energy budget as the surface temperature warms? That is the cloud feedback, and it tells us if clouds amplify or mitigate global warming.”

To determine the cloud feedback, Dessler and his research partners analyzed cloud data from 2000 to

2010 collected by Moderate Resolution Imaging Spectroradiometer (MODIS) and the Clouds and the Earth’s Radiant Energy System (CERES) system, both of which fly on NASA satellites. “These two methods are completely independent methods with almost no commonality,” he said. “The results agree remarkably well and give us confidence in our results.”

The data show, said Dessler, a slightly positive cloud feedback, indicating that clouds actually have an amplification effect on climate change. “I don’t see any evidence that clouds are going to cancel out other feedbacks and the Earth is not going to warm,” he said.

“There is just not any data to support that, literally zero.”

Dessler also pointed out that his research did not use climate models. “You hear people say that all we really have are climate models, but I didn’t use any climate models. This research is really based on data,” he said. “But the answer we get is the same as what the climate models tell us. It is fair to say that we can expect a few degrees of warming in the next century if we continue emitting CO₂ at the rate we are going: A few degrees of warming is quite significant; it should compel your



INVENTOR JEFF KOPLOW (8366) (right) discusses the “Sandia Cooler” with Andrew Dessler, who visited several laboratories and learned about Sandia’s work on Raman Lidar and ARM-UAV. (Photo by Randy Wong)

attention.”

While at Sandia, Dessler also visited the Particle Diagnostics and Mobile Climate Laboratories, hosted by Hope Michelsen (8353) and Ray Bambha (8128), and Heavy Duty Diesel Laboratory, hosted by Mark Musculus (8362). He learned about the Sandia Cooler from Jeff Koplow (8366); the Raman Lidar/Atmosphere Radiation Measurement Program from John Goldsmith (8132); and the UAV/Aircraft Program from Will Bolton (8123) and Robert McCoy (8123).

Sense of urgency drives push for new quality framework

By Christopher Miller

When members of Sandia’s Strategic Quality Management System Team meet, they hold nothing back. A sense of urgency and seriousness springs from the 20 Sandians as they discuss the need to deliver by Dec. 15 the framework for an integrated quality management system to strengthen the Labs’ current approach to quality. They sense the very well-being of Sandia depends on their work and on the concerted efforts of all Sandians to implement a robust quality system Labs-wide.



Sandia’s quality framework needs to be “elegantly simple” in that it should be “recognizable, understandable, usable, and easy to communicate across a variety of audiences.”
— Pat Smith, director, Mission Support and Governance

“Quality isn’t an office, it’s everyone’s responsibility,” says Mike Daily (1730), senior manager of Hi-Rel Electronic Products. “At Sandia, we have a security culture, we have a safety culture, but do we have a quality culture?” Team leader Cecelia Venuk (0426), who earned a black belt from Sandia’s Lockheed Martin Lean Six Sigma program and who has implemented quality management systems, agrees that Sandians must evolve their way of thinking about quality. “This is not about putting out the framework and thinking all is solved,” she says. “You then have to change people’s way of thinking. This is a big cultural shift.” Jack Loye (750), another senior manager and quality

team member, likens the quality framework they must draft to a declaration of independence. “This is just one finite means to an end,” he says. “This is like putting together a declaration of independence that serves as a framework of what we aspire to be. To do this is tough stuff and it’s a long journey.” Team sponsor Pat Smith, director of Mission Support and Governance (0700), says the framework needs to be “elegantly simple” in that it should be “recognizable, understandable, usable, and easy to communicate across a variety of audiences.” Pat says the framework should include sample measures that could be used to

show evidence that the corporate quality framework is effective across the Labs.

Once the team develops the framework, they will submit it to

the Quality Steering Council established in August by Kim Sawyer, deputy Labs director and executive vice president for Mission Support. The council’s long-term goal is to develop an integrated, corporate quality framework owned by the workforce and implemented across Sandia, and then to drive changes to behaviors and culture for sustained results. Kim serves as the council’s executive champion. Its members are VPs Steve Rottler (1000), Rick Stulen (8000), and Becky Krauss (11000); and Directors Rick Fellerhoff (400), Pat Smith (700), Anthony Medina (2500), David Williams (100), and Brian Bielecki (4200). Ultimately, the corporate quality framework will be discussed by the Laboratories Leadership Team before a

new system is implemented. Sandia has defined the Integrated Laboratory Management System (ILMS) as its means to document the Quality Management System, which is designed to address the ways Sandia does business and address requirements such as those contained in DOE Order 414.1D for a quality assurance program. The DOE order lays out the principles and requirements to ensure that all DOE and NNSA products and services meet or exceed customers’ requirements and expectations.

The quality journey

The decision to improve on Sandia’s current corporate quality framework can be traced to a series of events and issues over several years that peaked particularly in the areas of defect prevention and quality issues. Although Sandia was aware of the concerns and was working to improve them, an NNSA Sandia Site Office (SSO) report noted Sandia has shortfalls with self-assessments, monitoring the quality assurance program, and relying too heavily on after-the-fact lagging indicators. The LSO concerns prompted a compliance-based assessment of the quality assurance program in March. The assessment concluded that an overall system was not in place to ensure that quality assurance is implemented throughout Sandia. Sandia and a Lockheed Martin representative conducted concurrent self-assessments of the program, further identifying gaps and deficiencies that pointed to the lack of a Labs-wide common quality strategy and principles, which enable consistent and predictable product and program quality in all facets of its work. The shortcomings cited in Sandia’s quality assurance program included unclear roles and responsibilities; inadequate understanding and implementation of quality requirements and expectations; insufficient internal management oversight; and the existence of a quality management system that is too complex and

(Continued on next page)

Quality has always been integral to Sandia’s weapons work

Sandia’s roots trace back to the Manhattan Project and the development of the first atomic bombs. It has long been recognized for technical excellence and a strong science, technology, and engineering base. So how could quality be an issue for a laboratory that boasts of such a distinguished history? Quality has always been an integral part of Sandia’s work, says Larry Walker, director of Nuclear Weapons Planning, Operations, and Integration (200). “In the early days, we depended on the skills of the designers and they did a remarkable job,” Larry says. “We need to balance that approach by having a robust, reliable, repeatable set of quality processes and procedures.” Sandia adopted some early quality practices from Bell Labs, whose Quality Assurance Department provided such notable quality pioneers as Joseph M. Juran, who taught the Japanese quality after World War II; Walter A. Shewhart, the father of statistical quality control; and W. Edwards Deming, who coined the “plan-do-check-act” structure. The use of these quality practices allowed Sandia to establish an early reputation for both design speed and product quality, says Rick Fellerhoff, director of Surety Assessment, Engineering and Analysis Center 400. In 1954, Sandia became the quality assurance agency responsible for managing the US nuclear weapons supplier-base for the former US Atomic Energy Commission. Quality reaches extreme importance when the work involves nuclear weapons. Product Realization Teams (PRTs), composed of highly skilled engineers and managers with unsurpassed experience in the intricacies of weapon design and performance, develop working bonds that rival those of a well-disciplined Army platoon.

The PRTs develop their specialized expertise through education, training, and experience. They follow Realize Product Procedures (RPPs), the written instructions for conducting the research, design, development, surveillance, and retirement of a weapon. Sandia has about 150 RPPs that span the weapons lifecycle that are carefully assembled to include the plethora of requirements in DOE orders and manuals, NNSA weapons program requirements, federal regulations, and industry quality standards. Div. 1000 VP Steve Rottler initiated the creation of the RPPs when he was serving as



“It used to be that the weapon just had to work. Now the question is, how long will it work? Today’s weapons are exquisitely more complicated, and therefore quality must be that much more exquisite.”
— Deputy chief engineer Gary Sanders

Sandia’s chief engineer for nuclear weapons. Every step of the weapons work is carefully reviewed by the team, independent reviewers, and management to ensure requirements are followed from design to production. In addition, periodic audits based on Sandia’s eight corporate policy areas identify risks, track trends, measure progress to established metrics, and establish corrective actions when needed. The Surety Assessment, Engineering, and Analysis Center provides regular independent assessments of the nuclear weapons program, including implementation of work against the RPPs. The recent increase in weapons work associated with the B61 and W88 ALT life extension programs necessitates the need for a robust quality management system.

“We’re exercising the enterprise at a pace and scale we haven’t seen for a couple of decades,” says Gary Sanders, deputy chief engineer (2200). An added dimension is the increased complexity of modern weapons and the need to extend their lives for much longer periods of time. “It used to be that the weapon just had to work. Now the question is, how long will it work?” Gary says. “Today’s weapons are exquisitely more complicated, and therefore quality must be that much more exquisite.” Larry says despite the quality assurance processes currently in place, the expansion and growing complexity of the weapons program magnify the need for a robust quality management system to prevent defects. “We have encountered some challenges and it just reinforces the need for a good quality system. It’s essential we get it right,” he says. As a case in point, problems in 2011 with an electronic component made for a Sandia weapon program, which impacted production, is still a cause for disappointment. The costs associated with shutting down production and conducting forensic investigations to find the root cause were significant. “Quality saves us in the long run. The upfront cost may be big, but not as big as having to correct a problem or defect,” Gary says. The Nuclear Weapons program is focusing on five areas for improvement in FY13: (1) supplier management; (2) product acceptance; (3) improving the RPPs; (4) technical requirements management; and (5) knowledge development program training. Senior Manager Jack Loye (750) says you can never let down your guard when instilling quality. “If you have a quality world, you have to be uncomfortable and never be complacent because you’re always trying to improve,” he says. — Christopher Miller



“If we had one single taxonomy that applies to all of our work, no matter where you work within the Labs, it wouldn’t be a big change to go work for any one of the four Strategic Management Units.”

— Anthony Medina, director,
Energetic Components

(Continued from preceding page)

unevenly implemented to be clearly understood and used to prevent defects.

In June, Sandia developed a Corporate Quality Improvement Plan to address the concerns. The plan lays out eight areas for action that include performing gap analyses between the current and desired state of quality assurance; studying how the current system can be rolled into a single comprehensive quality assurance system; simplifying processes and procedures; benchmarking quality assurance with other labs and companies; and developing better performance-based metrics to measure quality deliverables and services.

Pat emphasizes that Sandia has a long history of quality and that the Labs already is applying many quality principles, but it must do a better job of applying them consistently across the Labs and then showing progress against established metrics.

“Quality is something we value. We do it for ourselves and we apply it to ensure we are providing quality products and deliverables to our customers,” Pat says. “Our continued drive toward excellence is important to controlling our own destiny. To be great, we have to continually improve. We’re not changing what we do, but how we do it.”

Consistently and predictably with confidence

Larry Walker, director of Nuclear Weapons Planning, Operations and Integration (200), says the definition of quality for him comes down to meeting requirements. “The goal is to have in place a management system that ensures you can do the work consistently and predictably with confidence,” he says.

“Historically, nuclear weapons worked from a ‘custom’ set of quality requirements, but we’re moving toward using more industry-accepted standards because it provides more consistency across the Labs,” Larry adds. “If we could all adopt similar standards then we would have a common language, making it easier for people to move from one program to another.”

Sandia’s nuclear weapons program and Integrated Laboratory Management System have obtained ISO 9001 certification for its management system, signifying it meets industry standards for its quality management system. In addition, many Sandia organizations have implemented ISO 9000, an entry-level quality standard.

Anthony Medina, director of Energetic Components Center 2500, agrees wholeheartedly with the concept of establishing a standardized quality management system across Sandia.

“If we had one single taxonomy that applies to all of our work, no matter where you work within the Labs, it wouldn’t be a big change to go work for any one of the four Strategic Management Units,” Anthony says. “It would be a big improvement if all the centers at Sandia spoke the same quality language in roughly the same way.”

In August, the Energetic Components Center became the first and only center at Sandia to achieve AS 9100C certification, a rigorous quality management system widely adopted within the aerospace industry. Anthony says it took his center two and a half years of continuous work to achieve it. “We require our [12] suppliers to be AS 9100C-certified, but we didn’t have that certification. That was somewhat duplicitous of us,” he says.

Anthony says he’s not sure AS 9100C should be expanded Labs-wide — that will be determined by the Labs’ leadership — but is sure the quality system is right for his center, which produces energetic components for nuclear weapons. “We needed it because of the kind of work we do. We have to manage people and deliver products for the nuclear weapons stockpile.”

Also receiving AS 9100C certification in March were two large Sandia projects: the Integrated Correlation And Display System (ICADS) and Ground Nuclear Detonation detection system Terminals (GNTs), two satellite ground systems that are crucial elements of the US treaty-monitoring apparatus. The customer is the Air Force Space and Missile Systems Center.

Senior Manager John Williams (5740) says certification for the satellite ground systems took about two years after then-Director Bruce Walker (5700) made the deci-

sion to pursue it and current Director Mike Cieslak (5700) continued to champion the pursuit. Achieving AS 9100C certification was the joint effort of centers 5700, 5500, 5300, and 2600, and was led by project manager In McCann and quality specialist Jane Poppenger.

“This team already had a lot of quality processes in place, but the journey to certification has improved us,” John says. “There’s something almost intangible that comes along the path to certification and that is a change in the culture.”

John says in addition to the Air Force touting Sandia’s certification, having it on the organization’s résumé helps when pursuing additional work under Work for Others.

‘Now we speak the same language’

Regarding Center 2500’s AS 9100C certification, Anthony says perhaps the biggest improvement brought by the new quality system is better document storage and sharing. “We’ve developed requirements for which documents you store, where you store them, what their name is, and how you update them. We’re developing SharePoint sites to post the documents so they will be easily accessible. And when you have a quality problem or issue, you can quickly look for systemic issues across projects and then correct them.”

Mike Daily points all who will listen to the scientific fundamentals of quality

Sandia senior manager Mike Daily (1730) is determined to spread the word about the value of applying quality principles and best practices to enable engineering excellence while also reducing costs. His focus is on preventing defects by detecting them early and correcting them before they become big problems.

“You can’t prevent errors, but you can prevent errors from becoming defects,” Mike says, paraphrasing Shigeo Shingo, a Japanese industrial engineer and quality expert.

Using the research literature from human factors, industrial engineering, and systems engineering, Mike has put together a two-hour workshop that he has given multiple times to grateful audiences throughout Sandia. Mike, an electrical engineer, oversees Hi-Rel Electronic Products, and in a previous job launched the Nuclear Security Quality Training Program to provide quality training on defect prevention methodologies for designers and quality engineers involved in new custom product development.

Mistakes are a fact of life and everyone makes them, Mike points out. The goal is to identify them at their source and then to implement some type of mitigating strategy. Identifying mistakes — or defects when they concern an engineered product — can be done after the product is completed (backend inspection), or after each step in the product realization process (source inspection).

Backend inspections require a re-evaluation of the entire product realization and inspection process to locate where the defect occurred, which is both time-consuming and costly. Source inspections locate the error at the source of the problem before it progresses to the next phase of product realization, which requires much less time and cost.

The defect in an electronic component made for a Sandia weapon program, Mike says, was a design defect discovered through a backend inspection during production, and subsequently cost both Sandia and the Kansas City Plant much more time and money than had it been discovered and removed during the design phase of the product realization.

Quality then is really a matter of defect preven-



MIKE DAILY

Anthony says many of the center’s approximately 250 people at first viewed the requirements as a burden, but “they now are seeing how it can help them do their jobs.”

Working with the center’s suppliers also has taken a positive turn. “Now we speak the same language. When there are issues, we can tell them where and how they need to get better and how it should be measured. We’ll even cite specific paragraphs in AS 9100C,” he says.

Anthony says the greater efficiencies gained from using the new quality system have allowed staff to devote more time to being creative and productive, including finding ways to improve their designs and identifying better ways to do their work despite continued dollar constraints.

In the early 1990s, Sandia was instrumental in establishing Quality New Mexico, with a mission to motivate and educate New Mexico businesses and organizations for quality achievement using the Malcolm Baldrige performance criteria.

“The Baldrige criteria have gained some recent traction at Sandia,” says Rick Fellerhoff, who sits on the Quality New Mexico Board of Directors. “In the last few years, Sandia’s Logistic Operations and Tech Area 5 operations received recognition for performance excellence from Quality New Mexico.”

tion. Mike says there are two types of defect prevention: (1) keep the defect from happening by minimizing or eliminating defect generators, which is hard to do; and (2) take away the defect’s power to cause harm by detecting and removing defects at the same project phase where they were generated.

If a defect generated in one phase of the product realization process goes undetected until the next phase, the cost of correcting it multiplies by an order of magnitude because of the costs associated with determining the cause of the defect, the extent to which other things are affected by the defect, and the need to redo much of the work done to that point.

Mike then shows how defect prevention can also be applied to ensuring quality results when conducting research. Each phase of the research process from planning and initiating the research, to performing the research, to peer review, and finally communicating the results and delivering prototypes based on the research provides multiple openings for possible defects.

Examples of some common defect types when “performing the research” are getting both false positives and false negatives, not tracking or understanding the uncertainties in the data, not following the scientific method, and not backing up data or documentation effectively.

“The best approach to quality is to focus on preventing problems — that’s where the value is,” he says.

Mike tells a simple story to illustrate how someone devoted to value will prevent an error from becoming a defect: A person receiving an order at a drive-up window at McDonald’s can hesitate after it is handed to him to inspect the bag to ensure it is correct (source inspection), or he can just drive off and check the bag when he gets home (backend inspection). The McDonald’s employee handing him the bag knew what it was supposed to contain, but probably didn’t have the same ability or commitment to ensure its accuracy as the person who would eat it.

The story exemplifies the difference between source and backend inspections, as well as the different perspectives of value added by someone who is following a script versus someone who has deep understanding and has to live with the consequences. The best quality inspectors are those who have that deep understanding of defect prevention best practices and are committed to applying them.

— Christopher Miller

Modular units crossing ‘Valley of Death’ for Air Force use

Sandia airborne pods seek to trace nuclear bombs’ origins



HARVESTER “ELVES” — Sandia researchers prepare pods that, airborne, will track radiation to its source and analyze particulates and gasses to identify a nuclear bomb’s origin. In foreground, Eduardo Padilla (in short-sleeve shirt) and Chisom Wilson (on one knee in running shoes) tune up the directional gamma radiation sensor (DGRS) pod. Scott Davison works by himself on the particulate sampling pod, while Joe Sanders (back left) inspects the Whole Air Sampling Pod (WASP). (Photo by Randy Montoya)

By Neal Singer

If a nuclear device were to unexpectedly detonate anywhere on Earth, the ensuing effort to attribute the weapon to its maker probably would be led by aircraft rapidly collecting radioactive particles for forensic analysis.

Relatively inexpensive unmanned aerial vehicles (UAVs) — equipped with radiation sensors and specialized debris-samplers — could fly right down the throat of telltale radiation over a broad range of altitudes without exposing a human crew to hazards.

This capability is far from fiction. In late September, a Sandia-developed airborne particulate-collection system demonstrated its capabilities in the blue skies above an Air Force base in Grand Forks, N.D. Dubbed “Harvester” for obvious reasons, the system “tasted” the atmosphere by using two particulate sampling pods to gather information. A third pod would provide directional guidance for a real event by following the trail of gamma radiation.

The three pods, with additional hardware, software, and ground-control equipment, are expected take their place on aircraft in the Air Force’s investigatory arsenal by 2014.

When they do so, they will have traversed the infamous technological “Valley of Death,” in which many promising R&D ideas die before reaching production.

The successful Grand Forks demonstration was part of a formal Department of Defense (DoD) Joint Capability Technology Demonstration (JCTD) that mated the Harvester modular pods to the long wings of a Department of Homeland Security Customs and Border Protection-provided MQ-9 Reaper UAV. (The Reaper is a more powerful cousin of the better-known Predator.)

While the recent tests did not include any radioisotope releases, the pods were able to collect and identify naturally occurring radioisotopes of lead and bismuth produced from the radioactive decay of atmospheric radon. In addition, radioac-

tive beryllium-7 produced from cosmic ray spallation of naturally occurring carbon-14 also showed up on the filters after the flight, providing a uniform measure for debris distribution.

The modular pods eliminate the need for costly, permanent aircraft modifications that would limit the number of aircraft platforms on which Harvester can be flown.

“There’s a high likelihood the Air Force will make Harvester operational in 2014 to augment its current manned aircraft collection capability,” says project lead Joe Sanders (5943). “For maximum responsiveness, we continually engaged with the Air Force to address its technological and operational needs throughout the project.”

The Harvester’s Directional Gamma Radiation Sensor (DGRS) helps guide the aircraft toward the radioactive plume using four large sodium iodide radiation detectors and a complex processing algorithm. The pilot, located far away in a UAV ground control station,

is informed by the Harvester equipment operator to fly toward the plume’s “hot spot.”

“The operator will see a vector that shows peak plume intensity up and to the right, let’s say,” says Joe. “It’s the equivalent of a guide saying, ‘You’re getting warmer.’”

Air passes through the samplers, each about the size of a small snowmobile, as the Reaper cruises at 200 mph. This rams particles into filter paper like light hitting a photographic plate, causing the particles to get stuck in the filter fibers. A separate radiation sensor analyzes the filter in realtime to estimate the type and quantity of radioactive particles collected. More extensive examination of the filters occurs after the aircraft has landed.

Because gas analysis can complement particle analysis, Sandia is developing a third type of pod called the Whole Air Sampling Pod (WASP) to demonstrate the feasibility of collecting multiple, large-volume air samples that can be analyzed for radioactive gases.

Radioxenons (radioisotopes of the noble gas xenon), if detected, can provide a telltale indication of a nuclear detonation.

“While not small, the 9-foot-long, 650-pound WASP is designed to be compatible with an MQ-9 Reaper UAV,” says Joe. “WASP has not yet been flight-tested, but has performed well in the laboratory, and the DoD’s interest in modular gas sampling is growing. We look forward to demonstrating the WASP technology and expect that it will also cross the Valley of Death.”

Harvester was developed by Sandia with support from the Albuquerque office of National Technical Systems, an engineering firm. The early R&D phase was funded by the National Nuclear Security Administration’s Office of Nonproliferation Research and Development. The later development and qualification phase was funded by the Defense Threat Reduction Agency and the Office of the Secretary of Defense’s Acquisition, Technology and Logistics Rapid Fielding Office as part of the JCTD.



CHISOM WILSON examines the flow of the particulate sampling pod. (Photo by Randy Montoya)

Sandia's Kauai Test Facility celebrates 50 years of rocket launches

By Heather Clark

Lee Stone traveled a quarter mile beyond the paved road's end 50 years ago toward about 15 white trailers along a raised concrete platform surrounded by sand dunes on the western tip of the Hawaiian island of Kauai.

The 31-year-old telemetry and electronics specialist was bringing equipment to the newly established Barking Sands Rocket Complex, where he saw the first Kauai Test Facility launch of a Nike Apache diagnostic rocket to measure radiation from a Strypi rocket taking off from Johnston Atoll during Operation Dominic in 1962.



END OF THE ROAD — Sandia's Thunderbird marks the turnoff to Kauai Test Facility (KTF) on the Pacific Missile Range Facility. (Photo by Heather Clark)

Lee's first recollection of Sandia's new rocket launch site was the sand dunes. "They started just bulldozing, shoving things around and pouring concrete, and they brought in 22 Nike-Ajax launchers," he says. Originally, the site was surveyed for 40 launch pads.

Fifty years later, Lee donned an honorary lei and joined dozens of Sandia employees, contractors, military personnel, customers, and political representatives to celebrate Kauai Test Facility's 50th anniversary.

KTF was established after an unwelcome Cold War surprise. On Sept. 1, 1961, the Soviet Union began full-scale atmospheric nuclear tests, conducting 45 tests in two months despite the Nuclear Testing Moratorium of 1958 that slowed rocket research.

"The United States was caught, frankly, flat footed," David Keese, director of Integrated Military Systems Center 5400, told those gathered. "We didn't have any nuclear device carriers that could launch those into the upper reaches of the atmosphere, we didn't have any sampling rockets so we could sample those effects, and we didn't have a launch facility that could do all that."

So, the then-Atomic Energy Commission created the Barking Sands Rocket Complex and in less than a year the US completed its first high-altitude nuclear test, David said. KTF's original name came from the sound underfoot of the fine coral sand nearby.

That first year, Sandia launched diagnostic rockets to measure the effects of Operation Dominic air bursts and Dominic Fishbowl high-altitude tests.

Lee recalled his early days at KTF when he worked 14 to 16 hours a day and rockets took off between midnight and 4 a.m.

"Back in those days it was still tubes, not transistors," he says. He had to warm up the equipment for about a half hour, but still "the tubes would drift in frequency, so



TAKE-OFF — A target missile is launched into the night sky from a vertical launcher at KTF. (Photo by Scott Walkington)



HAWAIIAN BLESSING — Tom Takahashi, known as Uncle Tom, blesses the missiles launched from KTF. (Photo by Michael Bejarano)



KAUAI TEST FACILITY view of launchers in 1962.

every now and then we would tweak the receivers to make sure they were getting the best signal."

Over the past 50 years, KTF has launched more than 430 rockets. The facility supports the DoD Missile Defense Agency (MDA) Aegis Ballistic Missile Defense (BMD) Test Program, the Conventional Prompt Global Strike Program, and other Navy flight test programs.



DOE PRESENCE — DOE Trail marks the spot where the road turns toward KTF. (Photo by Heather Clark)

During this period, the relationship between the Navy's Pacific Missile Range Facility (PMRF) and KTF has become intertwined.

PMRF's executive officer, Cmdr. Garron Morris, said, "KTF is more a part of the PMRF team than a tenant at PMRF."

Eric Hedlund, test director of the Aegis BMD Program, talked about the development of KTF's work on missile defense. In 1995, two Strypi missiles launched from KTF proved that Aegis could detect, track, and engage medium-range ballistic missiles. Over the past 17 years, KTF has launched more than 50 rockets to support missile defense tests, Hedlund said.

"Without the facility, the instrumentation, and especially the people and expertise here, we would not have been a successful program," Hedlund said, later adding in an interview, "When we developed the instrumentation over the past 10 years, we made sure there wasn't duplicate equipment at both facilities. It was all complementary instrumentation. If you take away PMRF, KTF can't survive and if you take away KTF, PMRF can't survive. It's a synergistic relationship."

The celebration included the Hawaiian culture. Margaret Scheffer (5419) made leis for Lee and other honored guests. And Tom Takahashi, known as Uncle Tom, blessed KTF on its anniversary.

"Sandia is celebrating 50 years on this ground . . . there are another 50 more years to go," he said. "I ask the Heavenly Father to bless this place, to bless these people."

David ended the ceremony with thanks to the two dozen Sandia employees and Kauai-based contractors who oversee KTF's daily operations.

"You can have the best building, radar, telemetry, and missile system in the world, but if you don't have the people, then you don't have much at all," David said. "I want to say thank you to our folks here on this integral team for all the good service they have done over the past years and the good service we expect them to render over the next 50 years."



ERIC HEDLUND, test director of the Aegis Ballistic Missile Defense program, speaks at the 50th anniversary. (Photo by Heather Clark)



DAVID KEESE, director of Integrated Military Systems Center 5400, speaks at the KTF 50th anniversary celebration. (Photo by Michael Bejarano)

Fifty years of KTF milestones

Three historical periods of Kauai Test Facility describe the development of its work: the era of nuclear readiness from 1962 to the late '70s; the research era from the early '70s to the mid-'80s; and the missile defense era, which started in the mid-'80s and is ongoing.

Here's a timeline of milestones in KTF's history:

1962 — The Atomic Energy Commission acquired use rights to a part of the Auxiliary Landing Field Bonham in Kauai, also known as Barking Sands, for launching diagnostic rockets to measure the effects of Operation Dominic air bursts. (Operation Dominic was a series of nuclear test explosions conducted in the Pacific.) The Strypi research rocket was designed and built as part of the nuclear testing program to take a nuclear warhead into space for extra-atmospheric testing, Strypi later became the workhorse of Sandia's rocket program.



UP, UP, AND AWAY — A Sandia employee launches the weather balloons at Barking Sands Facility, which later became KTF.

1963 — KTF begins launching research, or sounding, rockets. Researchers studied high-altitude winds and tested various designs and combinations of motors, nose cones, and fins.

1963-76 — KTF supported the Nuclear Test Readiness efforts. Sandia was the nation's leader in small rocket technology development. Accomplishments included the Miniature Attitude Reference System platform; the spinning Attitude Control System, motor development, recovery systems, rocket system development, and radial and axial and V-Band separation joint development.

Late 1970s to early 1980s — KTF conducted science and technology launches for DOE, NASA, and DoD and launched the Sandia Winged Energetic Reentry Vehicle (SWERVE) three times. Reagan's Strategic Defense Initiative in the early '80s meant KTF got a facelift and the missile defense era began.

1988 — Strategic Target System (STARS) facility construction began.

1990 — KTF upgrades included a launch pad, a missile service tower to accommodate vertical launches of large missiles, electronics, computer systems, and several permanent buildings.

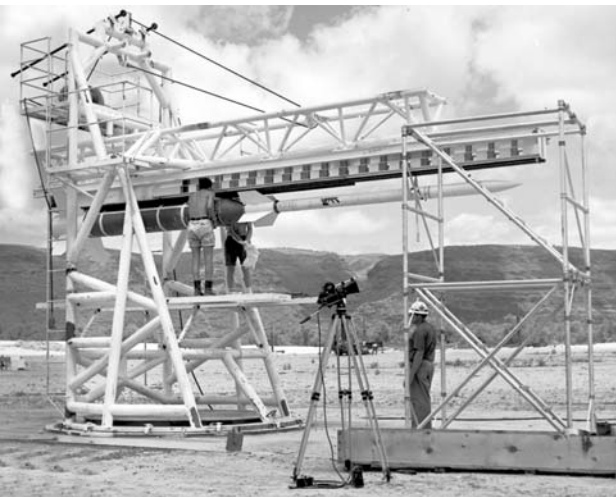
1993 — Strategic defense took off at KTF with the first launch of the STARS program. STARS Flight Test Unit 1 was the largest vehicle ever launched by Sandia at KTF at the time.

The technologies used for the first time by Sandia included thrust vector control during flight and a vertical launch.

1998 — KTF begins supporting the Navy's Aegis Ballistic Missile Defense tests.

2011 — KTF launches the successful test flight of the Advanced Hypersonic Weapon, the 14th launch of STARS.

2012 — KTF marks 50 years of successful operations.



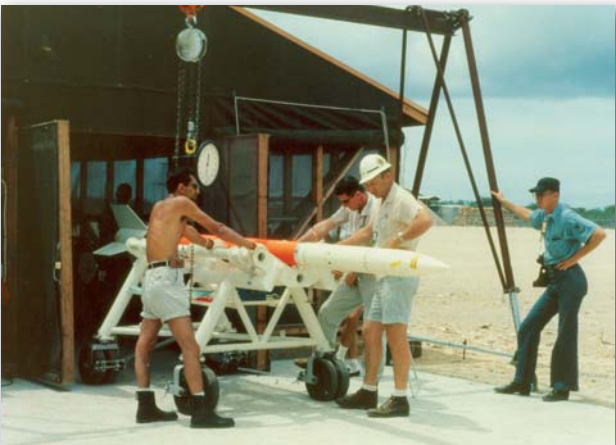
EMPLOYEES AT KTF work on a Hass launcher and rocket at Barking Sands, which later became KTF, in 1962.



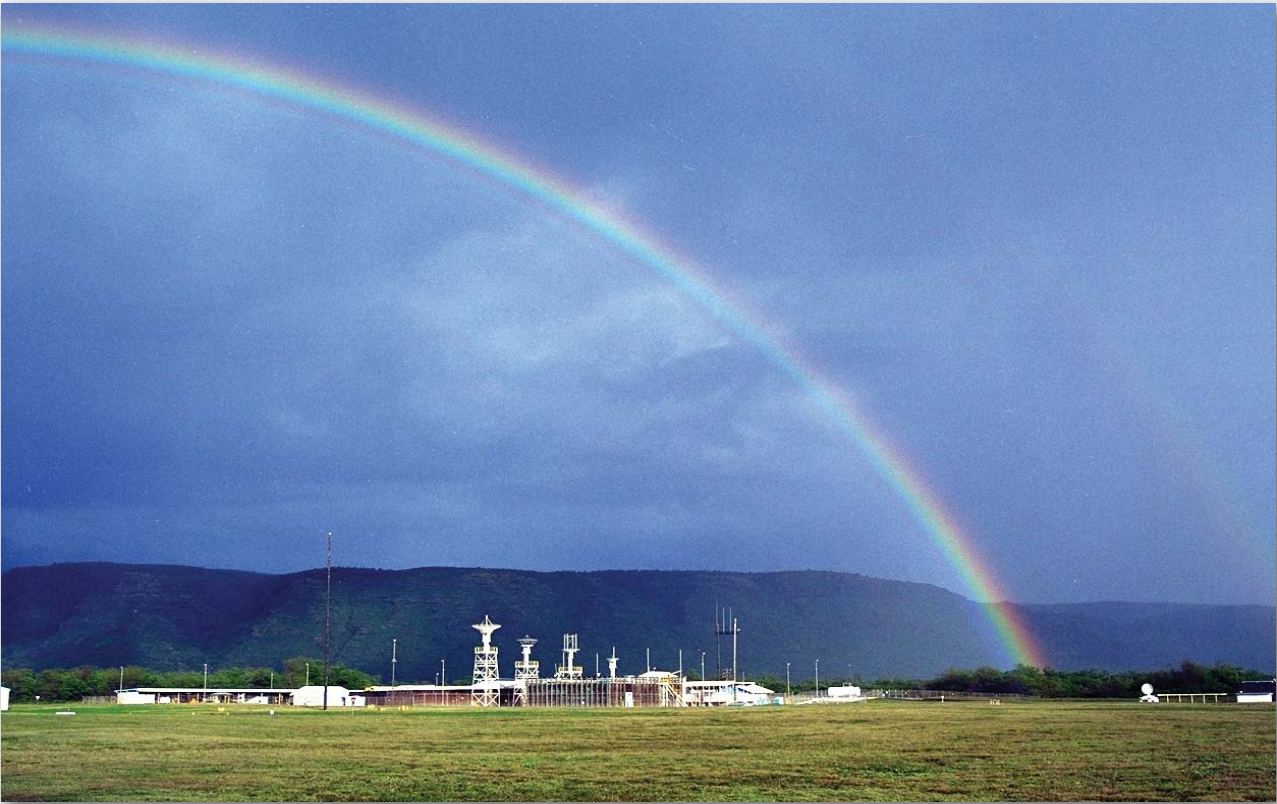
A SANDIA CREW poses for a photo in front of a launcher in 1973. (Photo courtesy of Hans E. Hansen)



LOB — The sun lights up the Launch Operations Building (LOB) with Makaha Ridge in the background.



READYING THE ROCKET — In the early '60s, high-altitude diagnostic rockets were built up and checked out in screen-rooms near the launch pads.



AFTER THE STORM — The LOB viewed from the launch field.

(Photo by Diana Helgesen)



CROWDED QUARTERS — Prior to construction of the LOB, rocket launches were conducted from inside instrument trailers like this one.



SANDIA EMPLOYEES who worked on the first launch at what later became KTF remember the sand dunes. In this photograph from 1962, it's easy to see why.

KTF team recovers from fire in three months to keep missions flying

“Imagine a dump for 10 million ashtrays,” says then-site manager Steve Yesner (5419-1), describing the smoke and water damage in the Kauai Test Facility’s Launch Operations Building (LOB) caused by a Jan. 15 fire.

The blaze could have delayed Sandia’s mission were it not for the KTF team that recovered from the disaster in three months’ time. In this 50th anniversary year, the KTF team showed its mettle and kept the missions on track.

“The recovery from the fire was remarkable,” manager Steve Lautenschleger (5419) says. “The folks based in Albuquerque and Kauai supported the recovery of the building, as well as preparing for the missions.”

It all started with a late-night phone call from the fire department to Steve Yesner, who managed the site until Oct. 1.

Responding firefighters encountered thick, black smoke pouring out of the LOB and water spraying from the indoor sprinkler system. It was later determined an electrical short in a dehumidifier within an air handling enclosure caused the blaze, Steve says.

The sprinkler system controlled the blaze, but failed to

extinguish the smoking equipment, Steve says. For that, firefighters used hoses, which caused the ceiling tiles to turn to an oatmeal-like consistency and collapse, he said.

“There was a standing inch of black water with soot throughout the building, this big charred mess where the coolers were, and a huge amount of smoke damage,” Steve says.

Going home that night, Steve thought about the next mission scheduled for early May and the colossal mess on his hands.

“We had three months to start from zero and be ready to conduct a trial test by mid-April,” he says.

Steve Lautenschleger says the first steps were to strip the rooms bare and catalog about 600 pieces of equipment before removing them from the building.

The teams from Orgs. 5419 and 5419-1 helped by creating a 25-page spreadsheet detailing all the equipment, removing smoke-damaged furniture and wall and floor coverings, restoring electronic systems, and validating that everything worked again.

“They documented and photographed everything before they touched it so they knew all the connections

and where they went,” Steve Yesner says. “It was just an incredible project. The fact that the team could do it in three months was absolutely amazing.”

Sandia hired a specialized cleaning company to clean the smoke damage, including the insides of computers and other equipment. Sandia resident contractors provided the labor to help lower the cost, he says.

The company used dry ice blasting to dislodge the grime and brought an ultrasonic cleaner and a special dryer to sanitize the equipment before it was reinstalled.

Dean Manning (5403), a former resident range manager at KTF, worked with Org. 5419 to develop a Mission Assurance Project Plan used to document that all systems were verified and validated prior to Center 5400 Director David Keese authorizing KTF to proceed with the next mission.

The April tests showed they could be ready for the May launch, which was a success. Several changes have now been made in the LOB to prevent such extensive smoke damage.

“Failure was not an option,” Steve Yesner says. “It’s the Sandia way.”

Kauai Test Facility

Stories and photos by Heather Clark • Historical photos courtesy of Sandia Archives

Flying to the future: Super Strypi coming to KTF, other projects explored

At the southern end of the Pacific Missiles Range Facility (PMRF) about eight miles from the Kauai Test Facility (KTF) sits a gray, metal pedestal. The concrete pad underneath the remnants of the rail launcher is surrounded by a chain-link fence with DOE No Trespassing signs posted on it.

Today, the site looks forgotten, but it’s about to get busier as Sandia’s and PMRF’s plans to help support cost-effective orbital launches come to fruition. Soon the site could be the launch pad for the Super Strypi, says David Keese, Director of Integrated Military Systems Center 5400.

“It’s a good combination of Sandia’s range expertise and our booster expertise,” David says.

But that’s just one plan for the KTF’s future. David and others are working to diversify this national asset to

accomplish more national security missions, including: a test bed for energy surety for military outposts and to help the military reduce its logistical footprint; a directed energy testing site in a maritime environment; and for renewable energy projects.

Vincent Salazar, senior manager of Missile & Air Defense (5410), says the next-generation Super Strypi program will provide cost-effective access to space from Hawaii for satellites carrying payloads of 5 to 240 kilograms that would stay in low-Earth orbit for several years.

Sandia is partnering with PMRF, Operationally Responsive Space, and the University of Hawaii, where students would help build and design the small satellites and be able to put experiments into space, Vince says.

“We will put up satellites that have very specific tasks in mind,” he says. “They can be very small and

very tactical.”

Another project being considered is to create a test bed at KTF for forward-based military operational energy technologies designed to reduce the military’s logistical footprint, Vince says.

PMRF is the size of a forward operating military base and KTF is the size of a patrol base, but forward military installations need energy and technology to support themselves, says Steve Yesner (5419-1), Kauai’s former site operations program manager.

“Operational energy encompasses fuel, power generation, water distillation, and waste management; all of those needs have an energy footprint. It’s got to be portable and light weight, and ideally put on a soldier’s back,” he says. “KTF is an ideal facility to develop these technologies for wider deployment.”

Hawaiian culture

It doesn’t take long to get a taste of Hawaiian culture at the Kauai Test Facility (KTF). I had been there for a couple hours when I found myself tasting “Hawaiian caviar.”

The smoked snails, called blackfoot limpets or “opihi,” were gathered from the beach that morning, smoked, covered in a spicy soy sauce, and eaten right out of the shell. They were delicious.



BEACHSIDE BASE — PMRF is located at the westernmost tip of Kauai where beaches abound.

KTF is imbued with Hawaiian culture and KTF’s employees and managers are keenly aware of the importance of understanding that culture.

“If we weren’t respectful of the culture, we wouldn’t have survived out there,” says Vince Salazar, senior manager of Missile & Air Defense (5410).

KTF abuts an ancient, sacred burial ground still visited by descendants of those laid to rest there. Visitors are told



ROOSTERS — Because Kauai lacks natural predators, roosters and chickens roam freely all over the island.

if they find anything that could be an artifact, they must report it so it can be returned.

I asked Kim Medeiros (5419-1), who came to KTF through the Student Internship Program, about the region KTF calls home. Within a few hours, she handed me a 63-page history, *Mana, the Place and Its People*, about the farming region historically known for its sugar cane plantations. The word “mana” means arid and hot in Hawaiian.

The sugar cane farms left several years ago due to foreign competition, says Michael Mier, who has been groundskeeper at KTF for 26 years.

Today, driving to KTF, green John Deere tractors plow the red-dirt fields planted with seed crops and horses are tethered alongside the highway.

Kim says she often shares what she knows of the culture and the cuisine, which is influenced by Chinese, Japanese, and other Asian cultures, with newcomers. “All the visitors who come here become like family,” she says. “If they want to open up to the culture, then we’re more than happy to share it with them.”

Many of those who work at KTF have stories about friendships with Hawaiians or how Kauai changed their lives. Julie Rentrop, the office administrative assistant who welcomes visitors with hugs, met her husband, a surfer, on a Kauai beach. Ken Dama, who heads the Wolverine contractors, made his home there after a vacation.

“The Hawaiians are a very friendly, family-oriented group,” Margaret Scheffer (5419) says. When meeting Hawaiians, for example at the start of a meeting, Margaret talks with them about their welfare, their families and kids. Once relationships are established, “they will bend over backwards to help you.”



LUSH VIEWS: It’s no surprise that Kauai is known as the Garden Island.



MECHANICAL OPERATIONS ENGINEER Casiano Armenta (4824) checks out a heat exchanger in Bldg. 726 that's part of Sandia's free-cooling system. Free cooling is the use of cold, dry outside air in late fall, winter, and early spring to chill water for air conditioning in data centers that need year-round refrigeration. Water runs from a cooling tower through the heat exchanger and straight into buildings, bypassing energy-consuming chillers. Free cooling has helped Sandia cut energy usage by more than 250 billion BTUs the past six years and reduce greenhouse gas emissions. (Photo by Randy Montoya)

Initiative unites facilities and R&D in Labs-wide sustainability push

An eye on resources

By Nancy Salem

Sandia has launched the Sustainability Innovation Foundry to work toward making resource conservation a Labs-wide effort and to help channel research in fields related to sustainability into business opportunities.

"Sandia has experience on the facilities side and a tremendous wealth of knowledge on the R&D side," says Jack Mizner, manager of Facilities Partnerships & Planning Dept. 4853. "We've been trying to figure out for a long time how to connect the two. We think we've finally made the connection."

The Foundry will bring together conservation and research to demonstrate Sandia's commitment to sustainability, says Howard Passell (6926), an ecologist in the Earth Systems Analysis group and a key organizer of the effort.

The goal is to institutionalize sustainability at the Labs. "All big institutions around the world need a smaller resource consumption footprint," he says.

Margaret Ochs (6124), another Foundry organizer, says government and industry organizations are looking for ways to embrace sustainability. "Sandia should be a leader in demonstrating and researching effective pathways to sustainable institutions," she says.

Howard says the science and technology of sustainability is expanding worldwide and at Sandia in such fields as climate, alternative and renewable energies, carbon sequestration, micro and smart grids, energy and water conservation, transportation, urban planning, infrastructure, and the energy-water-food ecosystems security nexus.

"We are arguing that sustainability will be increasingly important as the years go by, as population and resource consumption go up, and resource availability goes down," Howard says. "Sandia is already a leader in sustainability science and technology, and improvements in sustainability at our own site put us out ahead as well."

Mission-critical and sustainable

Sandia is on track to meet an ambitious goal of cutting energy intensity in buildings 30 percent by 2015 using a 2005 baseline, Jack says. Strategies include free cooling — using cold, dry outside air in late fall, winter and early spring to chill water for air conditioning — and sophisticated controls on lighting, air flow, heating, and cooling. Water usage has been reduced significantly through such efforts as replacing the steam plant with centralized boilers. And more than 10 percent of the Labs' total square footage is LEED-certified by the US Green Building Council.

Jack says Foundry projects could lead to even greater

energy savings. "We keep trying to march down that line of being a model for the DOE and the federal government of how you can run effective mission-critical operations and still be sustainable," he says.

The Foundry has received funding that will go to conservation projects and to leverage R&D capabilities at the Labs. "As a result of the funding, we will be able to bring more people into the group and do some useful work," Howard says. "It really brings this to life."

The financial return is through resource savings and recognition as a top-rank sustainability R&D lab. "That will bring us more business," Howard says. "Sustainability is already one of the most important thrusts in science and technology in the world, and will just become more so."

The Foundry's first funded project is Institutional Transformation, which will produce a simulation model of the costs and benefits of different energy and water conservation scenarios for buildings at Sandia's New Mexico and California sites. "The idea is that built infrastructure in developed countries is all high energy- and water-consuming. Usage will be forced down by energy and other resource shortages," Howard says. "So how do you transform a built infrastructure to lower the footprint when you have 700 buildings across two sites and hundreds of square miles? How do you go about doing it in a cohesive, thoughtful way?"

He says the project will produce a strategy to allow Sandia to comprehensively plan future development and where investment needs to take place to shrink its energy footprint and improve sustainability.

Raising the profile

The Foundry will also develop proposals, workshops, papers, collaborations, and other projects to raise the profile of sustainability at Sandia and create links between sustainability and national security. "By creating a Foundry central to the excellent ongoing work in energy-water-food resource areas that relate to sustainability, we will draw more attention from potential sponsors to the concentration of work here," Margaret says.

The Foundry recently hosted a workshop on Community Based Social Marketing by Doug McKenzie-Mohr, an expert on how to change workforce behavior to cut energy usage and waste, and use resources more efficiently, to achieve corporate goals. McKenzie-Mohr is working with Sandia on a communication and marketing strategy to promote change. The Foundry also hosted Martin Kimani, an expert on sustainable peace in Africa and director of the Conflict Early Warning and Response Mechanism organi-

zation based in Ethiopia. And the Foundry brought in community leaders from the University of New Mexico, city of Albuquerque, and businesses to discuss potential collaboration on sustainability.

The Foundry has launched a competition within Sandia for sustainability research ideas. Abstracts have been collected and are being evaluated. "This competition will support the winners with seed funding to develop ideas that might be used for further proposals or even as-is to help foster the Sandia sustainability effort," says Jerry McNeish, manager of Quantitative Modeling & Analysis Dept. 8954 and a Foundry organizer.

Howard says Sandia is not alone in the sustainability movement. Other national labs, universities, and institutions are joining the dialog.

But Sandia wants a leadership role. Howard says the Labs can set the benchmark in innovative large-scale transformation to a sustainable carbon-neutral environment while increasing mission effectiveness, resource reliability, and security.

"We want to make Sandia a cutting-edge institution in terms of its own conservation footprint and a world leader in sustainability science and technology," he says. "We want to leverage our existing R&D capabilities for greater value to Sandia and develop tools that can be used all over the world."

What is sustainability?

The most-quoted definition of sustainability can be traced to the 1987 report "Our Common Future," also known as the Brundtland Report, from the United Nations World Commission on Environment and Development.

The report addressed the interdependence of nations in the search for what it coined a "sustainable development" path. It defined sustainable as growth that "meets the needs of the present without compromising the ability of future generations to meet their own needs."

Howard Passell (6926) of the Earth Systems Analysis group says he prefers a definition that goes beyond human demand for resources and considers the resource systems themselves. "All complex systems oscillate," he says. "A sustainable system oscillates more or less regularly and returns to some kind of average behavior. It recovers from shocks. We argue that sustainability and resilience are very closely related.

"Resilience is the quality that allows a system to be sustainable. A system that is not resilient to shocks will crash in one way or another. Human systems in which resource demand is high but resource availability is low will be fragile, non-resilient, prone to crashes, and therefore not sustainable."

Upgraded Land Mobile Radio provides new capabilities to Sandia and KAFB community

By Stephanie Holinka
Photos by Randy Montoya

You might think that in a time of smart phones and iPads, 2-way radios have gone the way of the dinosaur. But you'd be wrong. Many critical functions at Sandia and KAFB still rely on 2-way radios for communications, both routinely and in case of emergencies. That system is getting an important upgrade.

Sandia's Land Mobile Radio (LMR) system provides 2-way radio communications to all federal government 2-way radio users on KAFB. Thousands of subscribers use the system, including DOE and DoD, as well as Sandia medical, maintenance, ES&H, Pro Force, escorts, and custodial staff.

Brian Bielecki, director of Security & Emergency Management Dept. 4200, says the KAFB community depends on the system 24/7.

"Anybody in the field whose radio has an incident commander channel scheduled into their work, uses the system," says Pat Manke, manager of Information Systems Program and Projects Dept. 9335.

Despite advances in cellular phone technology, the radio system's capabilities and reliability cannot be duplicated using current cell phone technology.

"When the incident commander talks during an emergency, he's talking on the 2-way radio to thousands of people at the same time. Right now, you can't just 'trunk' cell-phone users together like that," Pat says.

In an emergency, first-responders have priority access to channels. If needed, lower-priority users can be bumped from the system to provide full support to those responding to emergencies.

The previous system, which had been in place since 2005, is nearing the end of its lifecycle, and Motorola announced it will discontinue support for the system in December.

"The old equipment is end-of-life, so there was a big push to get this updated system up and running before the older system lost its manufacturer support," says IT system specialist Ken Bernier (9335), who installed the new system.

The upgraded system tower is hosted on the same remote hilltop on base as the old system, on Air Force property. The previous road leading up to the tower was beyond a 45-degree grade; maintenance trucks were winched up to the site prior to recent road improvements paid for by IMS and completed by the Air Force. Even with road improvements, it's not an easy site to visit.

Ken says another change is the use of multiple clients, so that the system is accessible from many locations, which also allows people to access the system information remotely. That's helpful due to safety issues related to weather, but it's also more efficient, since often the system problems are at another location and not caused by anything located at the tower. The replacement system meets Project 25 (P25 or



ENJOYING THE VIEW — Ken Bernier and Patrick Manke at the remote hilltop hosting the new land mobile radio tower.

APCO-25) standards for digital radio communications, used by federal, state/province, and local public safety agencies to allow better communication with other agencies and mutual aid response teams in emergencies.

Sandia's Project 25 compatible system could serve as a jumping-off point for other local entities to upgrade their emergency response communications infrastructure in preparation for national inter-operability. New systems can be trunked together with other systems. In the future, that could allow Sandia to scale the system up so that up to 30 remote sites, such as other national labs and government locations, could participate directly, allowing them real-time access to the same information that the first responders have on our site.

The project benefitted from the assistance of Infrastructure Operations Center 4000, which helped characterize what the system's users would need and negotiated with KAFB. The implementation team

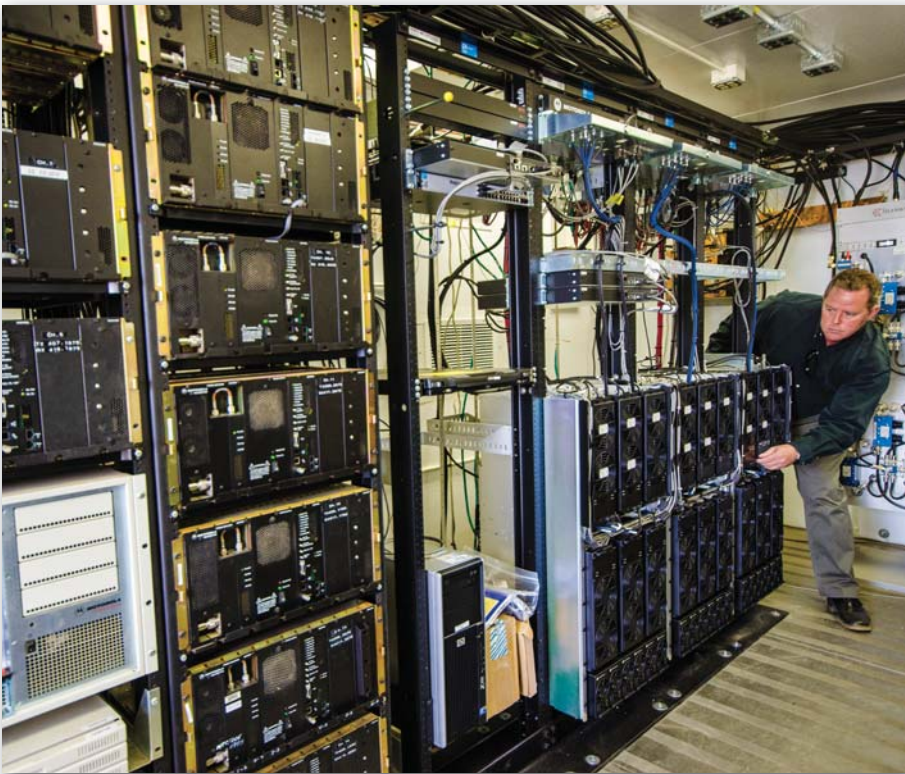
would like to thank VP Mike Hazen, director Brian Bielecki, senior manager Mike Schaller, manager Eugene McPeck, and buyer Jake Sena for their hard work and support.

Additionally, the team would like to acknowledge the work Chief Information Officer Mike Vahle (9000) and Computing & Network Services director John Zepper (9300), and their team, who assisted in creating the technical specifications.

Senior manager for Management & Assurance Systems Jack Loye (750) helped craft a competitive bidding process that resulted in lowering the costs to nearly half of the original budget estimate.

Brian says the project provides an example of teaming that needs to occur across multiple divisions to procure, install, and operate cost-effective infrastructure systems.

"It's a critical service for the Labs, and for the entire KAFB community, who all rely on those emergency communications," says Brian.



KEN BERNIER shows off the new system (right) compared to the much larger, older system (left).



OVER THE TOP — The lonely, treacherous road to the new tower is vastly improved from the previous road, which required a truck to be winched up to the tower.

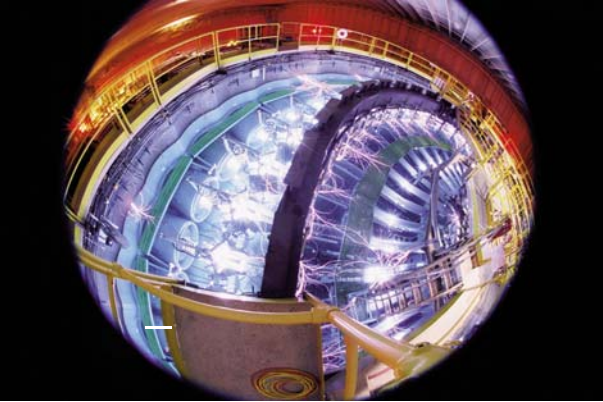
Nuclear weapons — the third era

The Cold War era



TSAR BOMBA — the “king of bombs” — was developed by the Soviet Union in 1961 at the height of the Cold War. Designed more for its political significance than for its military usefulness, the Tsar Bomba’s design yield of up to 100+ megatons of explosive power was intended to inspire shock and awe among the Soviets’ adversaries — namely the US — and impress the world’s nonaligned nations.
(Photo from Wikimedia Commons)

The Stockpile Stewardship era



AFTER THE END OF THE COLD WAR and the decision by the US to cease its long-standing underground nuclear weapon testing program, the nuclear enterprise turned to the tools and techniques of science to certify the safety, security, and reliability of weapons in the stockpile. Sandia’s Saturn device, seen here, has helped scientists increase their understanding of the physics of nuclear detonations.
(Photo by Randy Montoya)

The Stockpile Modernization era



EVOLVING out of the Stockpile Stewardship era, the Stockpile Modernization era presents the nuclear weapon enterprise with new challenges: How to keep the nation’s primary strategic deterrent safe, secure, and reliable for the next generation. In this era, Sandia will play a central role, performing the warhead systems engineering and integration and the nonnuclear component design work for the nation’s 21st-century stockpile.
(Photo from NNSA)

(Continued from page 1)

weapon designs, rapid turnover of systems in the stockpile, and a de facto, money-is-no-object approach to the science and engineering challenges of a time when many thought nuclear weapons could bring the world to an end.

Even the best-informed Cold War observers considered conflict with the Soviet Union as the dominant historical reality as far into the future as the imagination could see. This bipolar world was as fixed in human experience as the changing of the seasons, as fixed as the polar star. In this view, the two superpowers would slug it out — metaphorically, it was hoped — in every sphere of human endeavor, not least in the race for more and better nuclear arms.

But then, just as abruptly as the Cold War era started with the end of World War II, it came crashing down right along with the Berlin Wall. The national security context that had driven US nuclear policy for two generations had to be examined, rethought, and retooled.

Science-Based Stockpile Stewardship

The end of the Cold War marked the launch of the second era for the US nuclear weapons enterprise: Science-Based Stockpile Stewardship. At the dawn of this era, the US in 1992 adopted a unilateral moratorium on underground nuclear weapon testing, a bipartisan-supported policy that continues to this day. No longer were underground tests the key tools in certifying weapons for the stockpile and in gaining a deeper understanding of the performance and effectiveness of our arsenal.

The compelling challenge for the nation’s nuclear weapon enterprise during this time was very clear: How do the nation’s weapon scientists and engineers maintain and advance an understanding of weapon-related phenomena in the absence of physical all-up nuclear tests? What kind of experimental and computational capabilities are essential substitutes for underground tests? How do you develop and deploy those capabilities in a way that, somehow, will give the same level of confidence as feeling the earth rumble?

Sandia in this second era created new science-based tools and diagnostics, but the focus was on Los Alamos and Lawrence Livermore national laboratories. Because Sandia’s primary responsibilities for the stockpile are warhead systems engineering and integration as well as nonnuclear weapon component design and production, the end of underground nuclear testing didn’t impact Sandia’s mission work to the extent it affected the nuclear design labs. Sandia was no longer able to expose nonnuclear components to the harsh radiation environments created during full-scale nuclear testing, but we could still perform functional testing of these components under extreme mechanical, thermal, and electrical environments just as we had since the 1940s. For LLNL and LANL, however, full-scale functional testing of their nuclear components was not possible, so big science experiments and big simulations to make

sense of those experiments became the indispensable alternatives to underground testing. The quest was for data that recreated, simulated, or modeled the behavior of nuclear components at the moment of detonation, and for creative ways to compare that data to every nugget of information in the nuclear test record.

While the challenges of the era were as clear as day, what remained murky were the requirements and desired characteristics of the nation’s nuclear stockpile. The nuclear arsenal of the Cold War seemed obsolete in the context of the changing global security landscape; the clarity of the Cold War grew dim in the uncertainty of this new era. Should we be prepared to deal with a resurgent Russia, a muscular and emerging giant in China? Or would we need a different kind of stockpile to deter rogue states and non-state foes? These uncertainties led to the authorization and then cancellation of new weapon designs such as the Robust Nuclear Earth Penetrator and the Reliable Replacement Warhead. The W76-1 Life Extension Program (LEP) was the only major stockpile refurbishment during this era, and the conclusions of our Annual Assessment process clearly indicate increasingly urgent needs associated with stockpile aging and technology obsolescence.

Far from being locked into past designs, then, Sandia in the new era is being flung into the future as we design and deploy the warheads that will provide US nuclear deterrence for the next half century.

**Deputy Labs Director
for National Security Programs Jerry McDowell**



The third era: Stockpile Modernization

In contrast to the end of the Cold War era, which came abruptly, the Science-Based Stockpile Stewardship era didn’t end so much as meld into today’s era of Stockpile Modernization. While we need a crystal ball to know where this era is headed, it is clear enough that the US will still rely on science-based stewardship, but with increased emphasis on modernizing both the weapons in the stockpile and the critical infrastructure that supports the nuclear weapon enterprise.

Sandia will be at the very heart of the work scope of the next two decades, performing the warhead systems engineering and integration and the nonnuclear component design work for the nation’s 21st-century stockpile.

Without a resumption of underground nuclear testing, the nuclear explosive package (NEP) designs for the modernized stockpile cannot stray very far from existing designs because this would invalidate the historical underground test certification basis of stockpile confidence. Since the responsibility for the NEPs resides at LANL and LLNL, the role of those laboratories during the new era will remain focused on continuing to deepen the understanding of existing designs, or vari-

ants they deem acceptable from a certification perspective, using science-based tools.

By contrast, Sandia’s components — the nonnuclear components that make up more than 95 percent of the weapon and turn the NEP into a militarily effective and logistically sustainable deterrent — are very much tied to technology advances in the private sector. While the NEPs are basically existing designs, Sandia couldn’t rely on existing designs for the nonnuclear components of a modernized stockpile even it wanted to: Many of the technologies in the existing stockpile, vacuum tubes for example, are not supported by the modern-day manufacturing base nor today’s educational foundations.

Far from being locked into past designs, then, Sandia in the new era is being flung into the future as we design and deploy the warheads that will provide US nuclear deterrence for the next half century. That means the bulk of the technical design work in the stockpile modernization era will be done at Sandia.

The Obama administration’s 2010 Nuclear Posture Review (NPR), called for a renewed investment in modernizing the enduring stockpile and the infrastructure to support the stockpile, while at the same time taking steps to reduce the role of nuclear weapons in US

national security policy. In particular, the NPR reiterated US extended deterrence commitments to our allies and called for the full scope life extension of the B61 nuclear bomb. Both political parties have embraced the administration’s vision of a modernized but smaller nuclear deterrent. In a Congress otherwise deadlocked over budget issues, where continuing resolutions have fixed government agencies’ funding at the levels of the previous fiscal year, there has been strong bipartisan support for a so-called “anomaly” for nuclear weapon work — that is, an exemption to

allow the nuclear weapon budget for fiscal year 2013 to increase over the previous year by approximately \$400 million.

Reflecting that increased support and Sandia’s key role in the new era, the Labs’ weapon budget has increased almost 50 percent over the past five years. In a time of mounting budget constraints, the increase demonstrates the scope of Sandia’s role and the scope and pace of the challenge. However, the funding does not suggest a return to the Cold War ethos of “money is no object.” Cost is very much a factor and while Sandia and the other laboratories will be challenged at the technical level in ways that they have not been in 20 years, they also will be challenged at the management and administrative level as never before to ensure that every single dollar invested by the nation in this Stockpile Modernization era will be spent to maximize the return on investment.

Although this third era is in its early stages and is characterized by uncertainties about funding and about the size and composition of the stockpile and its appropriate role in today’s geopolitical environment, one thing does remain certain: Sandia’s commitment to uncompromising excellence as it carries out the policies of the nation.

Employee death

Tragic accident claims life of Nina Poppelsdorf

Nina Poppelsdorf was doing what she loved best, scuba diving in the almost tropical waters off the coast of southern Florida during a Thanksgiving vacation. Then, tragedy struck: A rogue wave swamped the 45-foot catamaran she was on as it was coming back into port after a successful trip to an offshore dive site. Twenty-three people, divers, and crew, went into the water. Twenty-two people came out, most just shaken up, a few with minor injuries. Somehow, Nina, a highly experienced diver and a scuba instructor at the New Mexico Scuba Center, didn't make it. She drowned at age 54 on Thanksgiving Day.

Nina's friends and colleagues at Sandia were shocked and saddened that a woman so full of life and a source of joy to so many could be gone so abruptly, under circumstances so unusual that the story made national news.

Nina had been at Sandia for 20 years. An industrial hygienist, she had recently become senior manager of the Radiation Protection, Safety, and Industrial Hygiene organization, where she was responsible for several corporate safety and health programs. Nina led a Sandia team that helped in the response to the crisis at Japan's Fukushima nuclear plant in March 2011.

Nina's boss, Center 4100 Director Sid Gutierrez, remembers the qualities that made Nina an effective leader.

"What impressed me most about Nina was her willingness to step forward and help whenever it was needed regardless of whether it was her responsibility," Sid says. "She had a special knack for bringing people with different points of view together, a skill that was much stronger than she gave herself credit for. And, of course, she did not put up with any nonsense. She was refreshingly truthful."

As a fellow scuba diver and fellow West Virginian, CJ Backlund (4127) felt a special kinship with Nina. "She clearly possessed a gift; she was not only an effective



NINA POPPELSDORF

leader, but a compassionate soul," CJ recalls. "At one point we were discussing scuba diving and I was relaying my anxiety since I was relatively new to the sport. Her response was a laugh and a reassuring smile expressing confidence in me. Just keep doing it, she said, and remember the wonders of the dive. The anxiety would fade. So true! I will miss her."

Nina had "an incredible laugh," says longtime colleague Annemarie Rader (4143), who remembers Nina as being "very helpful, very good at her job. She always had a smile on her face. I will miss her very much."

Nina had a way of inspiring her colleagues in some unique ways. For example, Ted Simmons (4128) recalls the time Nina, who was then his manager, noticed he had hearing loss in one ear, something he hadn't even been aware of. She brought this to his attention during a performance review.

"Ultimately I obtained hearing aids due to her observation," Ted says. "This was typical of Nina's management. She was very aware of the performance of her subordinates and their particular limitations and respectfully helped them succeed. I became very loyal to Nina after working for her for a few years."

Brenda Bailey-White (4143) is grateful that even with her untimely death, Nina managed to touch lives in special ways.

"We have constant reminders here at work about safety," Brenda says, "Life is unpredictable. Fatal consequences can occur when we step beyond our normal lives. I'm sorry that this happened to Nina, but I am grateful to be reminded, in this sad context, that each of us is so much more than a worker among workers."

Al Bendure (4121) thrived under Nina's management style. "When Nina became the 4120 senior manager I was moved into the position she vacated as the manager of Dept. 4121. I appreciated the trust she placed in me. She was my advocate and adviser, listening to my proposals and helping me hone them to ensure their adoption and success, while allowing me the freedom to manage the department."

Sonoya Shanks (4121) speaks of "our beloved Nina," remembering her as that rare individual who saw the good in everyone. "When I hear the name Nina Poppelsdorf it brings a smile in my heart. She was a very trusting soul. She truly cared and you never felt that she sat in an unapproachable ivory tower. She always tackled the difficult problems that everyone was afraid to touch. Her most respected attribute was her honesty and her lack of a hidden agenda. You always knew the

truth with Nina. Her laugh would bring smiles to everyone because her happiness was contagious. She was not just a boss but a true friend and will be deeply missed."

Denise Fleming, Nina's OAA for five years, forged a deep and abiding bond with her. "Nina loved God, her family, and had a great passion for ES&H," Denise says. "She treated her staff with respect, fairness, and compassion. I have peace knowing that she was a Christian and is now in the presence of God. I loved her and I will miss her joyful laugh."

Michael Oborny (4127), too, remembers that "distinctive, infectious laugh," while Sue Kline recalls the stories Nina told of her life experiences. "My favorite is of her ice skating when she was in college. She encouraged us to enjoy life just by how she lived her own life," Sue says.

Nina connected easily with people at the human scale, but if you were a fellow scuba diver, you were sure to "click" with her in a special way.

Says Ken Sansone (4121), "Nina became my manager when I was in Radiation Protection Sample Diagnostics. We would talk about diving and compare our dive adventures. As tragic as Nina's death was, I take comfort in that fact that she was on vacation doing something that she really loved."

And Cheryl Schuster (0233) credits Nina with being instrumental in inspiring her to learn to scuba dive. "Nina always took time to talk to me about the safety of potential scuba diving locations. She made a difference in our scuba diving community and our community at large. And she was so giving of her beautiful singing, and so dedicated to national and global security and safety. I will miss her dearly."

Jonathan Halpern (4143) and Nina often swapped stories of the adventures and occasional trials and tribulations of living in the East Mountains. "We traded information and stories about new snow, sudden power outages, and other challenges of living in the mountains and the quest to get to work. She told me about the recent power outage when she was getting ready for work at 5:30 a.m. and the lights suddenly went out. She wasn't deterred in the least, taking things in stride."

Nina had a special yen for a culinary treat that might not be to everyone's taste, but suited her to a t. As Lisa Hooper (4127) describes it, "Nina loved to eat fresh mangos doused with Mexican hot sauce at lunch. It reminded her of the many trips she took to the tropics, being the 'quintessential mix of sweet, salt, and spice.'" Maybe a bit like Nina herself.

Sandia's R&D 100 Award winners recognized at plaque-hanging ceremony



R&D Magazine presents R&D 100 awards each year to researchers whom its editors and independent judging panels determine have developed the year's 100 most outstanding advances in applied technologies. Sandia's winners this year were: *Computer Chip Configuration for Neutron Generators*; the "Sandia Cooler," also known as the "Air Bearing Heat Exchanger;" *Microsystems Enabled Photovoltaics (MEPV)*; and *Preparation of Nucleic Acid Libraries for Ultra-High-Throughput Sequencing with a Digital Microfluidic Hub*.

LABS DIRECTOR PAUL HOMMERT (left) recognized Sandia's winners of this year's R&D 100 Awards at a plaque-hanging ceremony Dec. 3 at Steve Schiff Auditorium. Paul thanked the four winning teams for their passion to achieve. Two teams are from Sandia/New Mexico and two are from Sandia/California. Chief Technology Officer and Div. 1000 VP Steve Rottler (right) said the awards recognize people for high-impact research and Sandia as a place where people can be successful.

(Photos by Lloyd Wilson)



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MISCELLANEOUS

ELECTRIC LIFT CHAIR RECLINER; vacuum cleaner, Kirby; bass guitar; '04 Honda CRV EX, 4-dr., AT, 120K miles, \$10,500. Vigil, 220-6938.

GABLE GREENHOUSE, Spring Gardener, 10' W x 20'L x 9'H, used 1 season, \$400. Markovich, 573-9019.

KOREAN RED LACQUER VASE, w/mother of pearl inlay, \$100; 17-in. monitor, \$100; twin bedroom set, bookcase & more, \$450; DP barbell set, \$50. Smith, 268-5392.

DINING TABLE, w/6 chairs, 1 leaf, brown, \$400; china cabinet, \$250; dresser w/mirror, chest of drawers, antique gold, \$200. Aragon, 265-9109.

CHILD CARRIER, Deuter Kid Comfort II, almost brand new, \$140; Bumbo seat, \$16; more baby/kid items available. Liang, 505-823-1695.

LOVESEAT, gray, perfect for student, no rips, tears or stains, from pet/smoke free home, \$40; Little Earth Cyclone NM license plate purse, \$35. Maestas, 459-7650.

SPEAKERS, Polk: 2 black Monitor 60 floor standing; 1 RM8 center-channel, \$250 OBO. Homeijer, 541-250-0480.

TREADMILL, Super Pro-Form Crosswalk 397, like new, \$300; high chair, \$30. Blackburn, 250-9017, ask for Jackie.

YOUNG GIRL'S DRESSER, nightstand, mirror set, lovely, will send photos, \$250 OBO. Hickman, 553-0677.

ELECTRIC DRYER, Kenmore Elite, super-capacity, heavy-duty, white, many cycle options, \$125. Anderson, 505-250-2859.

BIRDCAGE, large, metal, white, 5-ft. tall, 16-in. diameter, can be hung from ceiling or freestanding, \$50. Garcia, 280-5815.

ELECTRIC PIANO, w/seat, Williams Etude, 3 pedals, 88 keys, 8 instruments/voices, recording, metronome, great condition, \$500. Tribble, 604-1312.

ACOUSTIC GUITAR AMP, Rocktron Rampage, excellent condition, \$100. Mann, 505-269-7302.

CONCRETE LUMINARIA BRICKS, >100, holds candles in place for safe burning, bags too, \$100/OBO. Catanach, 505-717-5617.

PRINCE TT AIR RIP TENNIS RAQUET, 4 grip, new condition, too powerful for me. \$30. Montoya, 296-4268.

PNEUMATIC FLOORING STAPLER, Stanley Bostitch U/MIIIFS, w/BCS1516 15-1/2 gauge hardwood staples, \$350 OBO. Homeijer, 541-250-0480.

EXERCISE BIKE, stationary, good condition, \$50. Castle, 505-850-7911.

CHAINSAW, Craftsman, 18-in., \$50; Black & Decker electric leaf blower/vacuum, \$50; blue icicle lights, 10 boxes, \$25. Goy, 505-410-0514.

BABY CRIB, mattress, linens, \$175; swing, \$35; playpen, \$40; bassinet, \$40; bathtub, \$10; girl clothes, NB-12 mos. Laslo, 235-6982.

PUPPIES, 2, male, Bishon/Maltese-cross, located in Bernalillo Co., 10 wks. old. Romero, 306-8815.

DIAMOND PENDANT, 1.19 carat, round, white gold, appraised at \$7,500 (included), asking \$2,500. Owen, 301-4349.

JUNIOR-SIZE DRESSER W/MIRROR, 5 drawers, oak, excellent condition, \$50. Philbin, 828-2414.

'ROCK OF AGES' TICKETS, 2 Popejoy, 7:30 p.m., Jan. 6, orchestra, row 14 on the isle, \$54.25 ea. Hoyal, 823-1421.

CONSOLE PIANO, Everett, oak, holds tuning well, good condition, \$1,000 OBO. Cafery, 899-8139, after 4:30 p.m.

TABLE, oak, 48-in. w/18-in. leaf, \$125; dresser w/mirrors, oak, large, beautiful, \$400; CD/DVD shelf unit, oak, \$45. Cocain, 281-2282.

CHRISTMAS IN BRANSON, condo, 3-bdr., 2 baths, 7 days/nights, Stormy Point Resort, \$500. Fraser, 806-341-7252.

CHILD CARRIER, Kelty Expedition, \$40; Bunn home coffee maker replacement carafe; ice tea maker, free. Weber, 573-8965.

WEDDING DRESS, strapless, shantung taffeta, sweetheart ball gown-style, never worn, David's Bridal, size 8, \$800. Romero, 505-717-6899.

LUMINARIAS, \$10 first dz., \$5 every dz. after, benefits non profit, will deliver. Black, 505-331-9147.

TRUCK TOPPER, blue, broken back window, \$150 OBO. Vinson, 681-2687.

BATH BAR LIGHTING, Strictly South-western, 48" x 9-1/2", oak, 6 lights, retail \$300, asking \$50. Chu, 858-1135.

TREADMILL, NordicTrack A2105, great condition, you pick up, \$100. Musgrove, 275-3355.

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

• EMAIL: Michelle Fleming (classads@sandia.gov)

• FAX: 844-0645

• MAIL: MS 1468 (Dept. 3651)

• DELIVER: Bldg. 811 Lobby

• INTERNAL WEB: On internal web homepage, click on News Center, then on *Lab News* link, and then on the **very top of *Lab News* homepage** "Submit a Classified Ad." If you have questions, call Michelle at 844-4902. Because of space constraints, ads will be printed on a first-come basis.

Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)

2. Include organization and full name with the ad submission.

3. Submit ad in writing. No phone-ins.

4. Type or print ad legibly; use accepted abbreviations.

5. One ad per issue.

6. We will not run the same ad more than twice.

7. No "for rent" ads except for employees on temporary assignment.

8. No commercial ads.

9. For active Sandia members of the workforce, retired Sandians, and DOE employees.

10. Housing listed for sale is available without regard to race, creed, color, or national origin.

11. Work Wanted ads limited to student-aged children of employees.

12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

DINING TABLE, oak, 40" x 70" w/20-in. leaf, 6 cloth-covered captain chairs, very good condition, \$450. Trellue, 292-7236.

GLASSWARE, etched parfaits (7), icers (8+), w/matching spoons & cocktail forks, beautiful, \$110. Wells, 292-0179.

TYPEWRITER, IBM Personal Wheelwriter 2, w/supplies; Sanyo TRC-8080 standard cassette transcriber; Norelco microprocessor transcriber. Long, 505-294-4591.

BATHROOM COUNTERTOP, tiled, 22-1/2"D x 42"L, w/china sink, gold finish fixture, cabinet, photo available, \$150. Willmas, 281-9124, ask for Jack.

MEN'S SNOWBOARD, Burton, 156 cm, great condition, \$145. Couphos, 973-214-0923.

TRANSPORTATION

'94 FORD F150, extended cab, lifted, manual, \$5,000 OBO, call 281-2597; '00 5th wheel, Wildwood, model 21RKLTL, 23-ft., \$6,000. Huppertz, 286-3287.

'05 MERCEDES S430, all options, green, tan leather, newer Goodyear Eagles, 57K miles, excellent condition, photos on Craigslist, <NADA, \$16,000 OBO. Dwyer, 271-1328.

'99 INFINITI QX4, V6, AWD, fully loaded, gold, tan leather, sun roof, 194K miles, good condition, \$3,900. Portillos, 366-9264, ask for Jared.

'00 BMW 323Ci, 5-spd., 34-mpg, premium CD, leather, 137K miles, excellent, solid, safe, sporty, \$6,700. Aas, 286-9057.

'04 MUSTANG GT CONVERTIBLE, 40th Anniversary pkg., 59K miles, excellent condition, \$11,200 OBO. Lujan, 505-401-5760.

'04 FORD F150 XLT, 4WD, super-crew, gray, shell, bed liner, Bluetooth, 98K miles, KAFB lot, \$12,500 OBO. Carpenter, 379-1737.

'09 TOYOTA CAMRY, 4-cyl., basic options, sun roof, new tires, 45K miles, very good condition, \$12,500. Hinga, 505-331-7108.

'12 BMW X5, xDrive 50i, sport/cold weather pkg., navigation, Bluetooth, heated/cooled seats, running boards, 30K miles, immaculate, \$57,500. Green, 239-6914.

'03 F150 LARIAT, 5.4L V8, AC, Tonneau cover, leather seats, more, 128K miles, \$9,000. Wallner, 836-5752.

'06 DODGE CHARGER SRT8, 6.1L Hemi, 425-hp, Inferno Red, GPS, 6-disc CD, leather, sun roof, stored, 3,800 miles, \$28,500. Cerutti, 269-3857.

REAL ESTATE

TRIPLEX, ea. unit 1-bdr., 1 bath, 530-sq. ft., near KAFB, good income property, newer AC, wood/tile floors, MLS# 729035, \$129,000. Lioce, 697-9521.

3/4-BDR HOME, 2 baths, 2,064-sq. ft., all brick, Los Lunas, near I 25, excellent condition, MLS#725292, FSBO, \$207,000. Kirkpatrick, 366-3200 or 238-2288.

3-BDR. CONDO, 2 baths, remodeled kitchen, NE Albuquerque, lovely, \$72,000. Mozley, 505-363-1543.

WANTED

TOYOTA COROLLA OR CAMRY, low mileage, '10-present; used dresser, nice condition. Mathews, 922-6078.

4-BDR. HOME, 2 baths, 2-car garage, looking to buy, NE Heights, Albuquerque. Rhea, 400-9314.

WASHER/DRYER, freezer, sectional, rugs, lawn mower, son moving out, anything appreciated. Losinski, 263-8506.

TIRES, all terrain, decent shape, size 31 x 10.5 R15 for Toyota 4WD. Buckles, 271-0592.

FEMALE ROOMMATE, share condo w/university student, NE Heights, Paseo/Ventura, gated community. Wisler, 828-4811.

CHRISTMAS LIGHTS, working or not, for high school science project on circuits, tangled lights welcomed. Padilla, 328-1264.

HANDYMAN, help tenants in Foothills home, small fix-its. Sullivan, 505-293-3344.

LIVING SPACE, >1 yr., for tidy, trustworthy, liberal lady w/2 medium-size dogs, budget: \$350/mo. Richards, 506-9571.

GOOD HOME, 11 yr. old Collie, female, spade, great w/children, extremely gentle. Finley, 293-1961.

WORK WANTED

WORK DURING WINTER BREAK, college student, available, Dec. 20-Jan. 17, house/pet/baby sitting, references available. Nelson, 828-2755.

HBE

BE A BETTER HEALTHCARE CONSUMER

Sandia Dental Care Program offers the choice to save

The Sandia Dental Care Program, like the Sandia Total Health medical plan, offers you multiple choices and options that will save you on out-of-pocket costs. We know that choice and savings are two things you value in your health and medical plans — and the Sandia Dental Care Plan has both.

The Delta Dental PPO and Delta Dental Premier Provider Networks

Dental Care Program has two in-network provider network options:

- Delta Dental PPOSM
- Delta Dental Premier®

Delta Dental Premier is the country's most extensive panel of dentists, with more than 139,000 dentists and more than 248,000 locations across the country. Delta Dental PPO is a second, smaller network (a subset of Delta Dental Premier) that includes more than 80,000 dentists in more than 166,000 locations nationally.

When you enroll in the Dental Care Plan, you may visit any provider in either Delta Dental network (Premier or PPO). The same benefit levels apply in each of these two networks, as shown here:

Services	Delta Dental PPO Network		Delta Dental Premier Network	
	Sandia pays	You pay	Sandia pays	You pay
Diagnostic and Preventive Services	100%	0%	100%	0%
Basic and Restorative Services	80%	20%	80%	20%
Major Services	50%	50%	50%	50%
<i>For more detail on the types of services which fall into the benefit categories shown above, consult the Sandia Dental Care Program (DCP) Program Summary.</i>				

Dentists who participate in Delta Dental PPO, however, have agreed to charge you less than Delta Dental Premier dentists for the services they provide. Because you pay a portion of the costs for most services (as shown above), when the total cost of care is reduced, your out-of-pocket costs are also lower.

To save you the most money, select a Delta Dental PPO provider whenever possible. Select a Delta Dental Premier provider when a more expansive panel of dentists is needed or desired.

If you elect to use a dentist who does not participate at all with Delta Dental, your out-of-pocket will be even higher because those providers can charge you amounts that would otherwise be disallowed by Delta Dental.

Delta Dental Networks by the Numbers

Some dentists — particularly some types of specialists — may not participate in Delta Dental PPO because of the level of fee reductions in that network. Other dentists participate in both Delta Dental PPO and Delta Dental Premier. When a dentist participates in

both networks, the lower cost of care with Delta Dental PPO automatically applies. Although the selection of specialists is generally broader with Delta Dental Premier, in the Albuquerque and Livermore areas many specialists also participate in both networks (as illustrated below). To be sure you capture all savings possible, when searching for a dentist online at DeltaDentalNM.com, select the Delta Dental PPO network instead of Delta Dental Premier when establishing your search criteria.

Specialty	Albuquerque Area		Livermore Area	
	Delta Dental Premier	Delta Dental PPO	Delta Dental Premier	Delta Dental PPO
Endodontics	13 providers	5 providers	111 providers	111 providers
Oral Surgery	18 providers	11 providers	113 providers	109 providers
Orthodontics	35 providers	22 providers	152 providers	73 providers
Pedodontics	15 providers	12 providers	71 providers	11 providers
Periodontics	13 providers	2 providers	125 providers	123 providers

The number of specialty providers shown above was accurate as of the date of this article. The most current provider network data is always available at DeltaDentalNM.com.

Out-of-Pocket Cost Savings Example

The table below shows how using a dentist in the Delta Dental PPO network can help reduce your out-of-pocket costs. The example assumes the actual dentist charges that would be allowed in New Mexico as of the date of this article. Charges shown are illustrative and actual charges allowed vary by location and date of service.

Single crown procedure (CDT code 2790)		
	Delta Dental PPO Provider	Delta Dental Premier Provider
Dentist submitted charge	\$1,142	\$1,142
Delta Dental maximum allowed charge	\$809	\$1,025
You pay 50% (co-payment for Major Services)	\$404.50	\$512.50

As you can see, you can have substantial savings — more than \$100 in a single procedure — by selecting a Delta Dental PPO dentist.

If you have any questions about your Dental Care Program benefits, review the Dental Care Program (DCP) Program Summary or contact HBE Customer Service at 505-844-HBES (4237) or Delta Dental at 800-264-2818.

CYANOBACTERIA

Engineering an alternative fuel source



SANDIA TRUMAN FELLOW Anne Ruffing looks at a flask of cyanobacteria with precipitated fatty acid floating on top. She has engineered two strains of cyanobacteria to produce free fatty acids, a precursor to fuels, as she studies the direct conversion of carbon dioxide into biofuels by photosynthetic organisms. (Photo by Randy Montoya)

By Sue Major Holmes

Sandia Truman Fellow Anne Ruffing has engineered two strains of cyanobacteria to produce free fatty acids, a precursor to fuels, but she's also found that production harms the organisms themselves, cutting into their production potential.

Micro-algal fuels might be one way to reduce the nation's dependence on foreign energy. Such fuels would be renewable since they use sunlight for energy. They also could help mitigate carbon dioxide emissions since they use photosynthesis and could create jobs in a new industry. President Barack Obama, speaking in February at the University of Miami, cited investments to develop fuels from algae, saying they could replace up to 17 percent of the oil the United States now imports for transportation, which depends on liquid fuel.

"Even if algae are not the end-term solution, I think they can contribute to getting us there," Anne (8622) says. "Regardless of however you look at fossil fuels, they're eventually going to run out. We have to start looking to the future now and doing research that's needed to be ready when the time comes."

Anne has been studying the direct conversion of carbon dioxide into biofuels by photosynthetic organisms under a three-year Truman Fellowship that ends in January. She presented her project at a poster session in August and published her work on one strain, "Physiological Effects of Free Fatty Acid Production in Genetically Engineered *Synechococcus elongatus* PCC 7942," as the cover article in the September 2012 issue of *Biotechnology and Bioengineering*.

Studies are proof of concept

Anne considers her studies as proof-of-concept work that demonstrates engineering cyanobacteria for free fatty acid (FFA) production and excretion. She wants to

identify the best hydrocarbon targets for fuel production and the best model strain for genetic engineering, as well as gene targets to improve FFA production.

She is working with cyanobacteria — blue-green algae — because they're easier to genetically manipulate than eukaryotic algae, the natural "oil"-producing photosynthetic microorganisms more commonly used for algal biofuels, and because they can be engineered to create a variety of target fuels. Genetically engineered cyanobacteria excrete FFA and allow fuel to be collected without harvesting the cyanobacteria. This lowers the requirement for nitrogen and phosphate and reduces costs.

But current yields from engineered strains are too low for large-scale production.

Anne favors cyanobacteria because fuel from engineered cyanobacteria is excreted outside the cell, in contrast to eukaryotic algae, in which fuel production occurs inside the cell.

Here's the general process: Eukaryotic algae grow in a pond to the density needed, then producers must get rid of the water, collect the cells, and break them open to get the fuel precursor inside. This precursor is isolated and purified, then chemically converted into biodiesel. Cyanobacteria excrete the fuel precursor outside the cell, so a separation process can remove the product without killing the cells. That eliminates the need to grow a new batch of algae each time, saving on nitrogen and phosphate.

While other research efforts have focused on metabolic engineering strategies to boost production, Anne wants to identify what physiological effects limit cell growth and FFA synthesis.

"You can't really hope to continue to engineer it to produce more of the fatty acids until you address these unforeseen effects," Anne says. "As much as you want to do the applied side of things, creating the strain, you can't get away from the fundamental understanding

that's necessary in order to do that."

The strains she engineered for FFA production show reduced photosynthetic yields, degradation of chlorophyll-a and changes in light-harvesting pigments, Anne says. She saw some cell death and lower growth rates overall, and suspects the toxicity of unsaturated FFA and changes in membrane composition are responsible.

Creating mutants

Now she's looking at what genes are changing when cyanobacteria produce fatty acids. She's creating mutants by knocking out certain genes or introducing or overexpressing genes to see how that affects the cell and fatty acid production.

"So I'm engineering the cell, then I'm trying to learn from the cell and find ways to work with the cell to produce the fuel instead of trying to force it to produce something it doesn't want to produce," Anne says.

Much of our fundamental understanding of photosynthesis comes from cyanobacteria, but it's only been in the past decade or so, with advances in gene manipulation and recombinant DNA technology, that they've been considered for fuel production, Anne says.

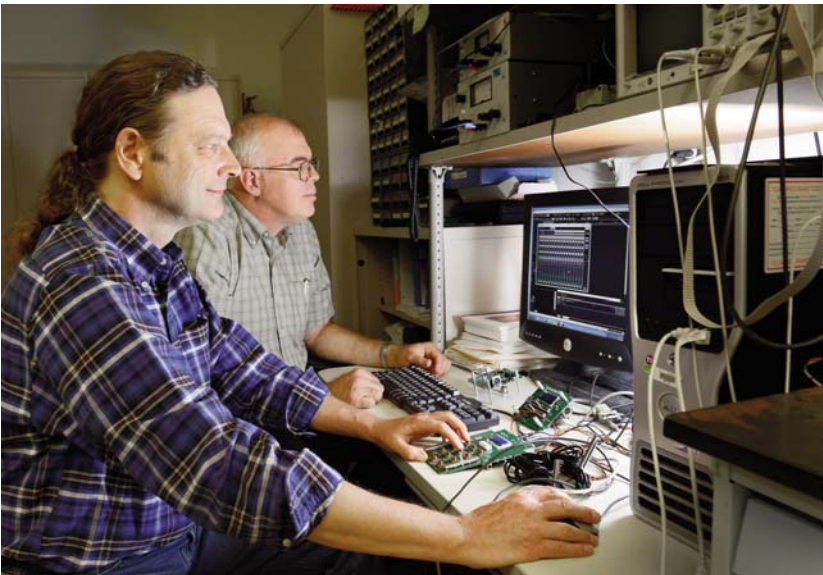
She's producing FFA from *Synechococcus elongatus* PCC 7942 and *Synechococcus* sp. PCC 7002, chosen as so-called model organisms that have been studied for several decades and for which tools exist to manipulate their genes. The work with 7942 is complete and published, but she's still constructing and testing 7002. She also is working with the two strains and a third, *Synechocystis* sp. PCC 6803, for biofuel toxicity screening.

She hopes to continue working on strain development after the fellowship ends.

"It is possible that maybe some other strain that's out there that's a natural strain could be a better option, so this is still pretty early on," she says. "There's a lot of exploration to do."

Music men

Disabled kids inspire a teacher and scientist to make an instrument anyone can play



TAOS MUSICIAN AND INVENTOR Dan Dailey, foreground, and Sandia researcher Kent Pfeifer (1716) tweak Dailey's MidiWing device, which helps disabled people play a musical instrument. (Photo by Randy Montoya)

By Nancy Salem

Not everyone can play music. It's hard. You need a sense of timing and rhythm, an ear for pitch and notes, and an ability to read and interpret sheet music and symbols. You need physical coordination to apply those talents plus control of lungs, lips, arms, and fingers to the mechanics of a musical instrument. And you need strength and stamina to sustain the sounds you create.

When I realized how difficult traditional instruments are to play, I thought there had to be a way to make things easier and more accessible for people without the incredible gifts I had been given."

— Musician Dan Daily

Taos musician Dan Daily can do all that. But he knows plenty of people who can't. "My mom had a daycare center for severely disabled children when I was young. Those children impressed me," Daily says. "They were pretty much regular people but with disabled bodies. That stuck with me."

Daily, who was raised in a musical family in Chicago, went on to learn 20 instruments, from woodwinds such as flute, saxophone, and clarinet, to keyboard and bass. He earned a bachelor's degree in music from the University of Illinois at Urbana-Champaign and a master's in music education from Indiana State University.

Bridging the gap

He never forgot the challenged kids his mom, a registered nurse, cared for. "When I realized how difficult traditional instruments are to play, I thought there had to be a way to make things easier and more accessible for people without the incredible gifts I had been given," he says.

Daily had a feeling electronics might bridge the gap between people with fine motor control and those without. Electronic instruments are designed like regular ones and require the same techniques and coordination, but Daily found he could separate the way notes are selected from how the instrument sounds. "With traditional instruments, note selection is intricately connected to the way the instrument is devised," he says. "With electronics you can divorce that."

Daily split them up. He made an electronic path for note selection and volume that did not depend on the

physical necessities of a traditional instrument. In the process he created a new instrument consisting of a microcontroller-based system that send signals through a USB connection to another electronic device, such as a sound module or computer, which then produces sound.

He named it MidiWing, a nod to the revolutionary MIDI (Musical Instrument Digital Interface) protocol, a set of commands that allows electronic musical instruments, performance controllers, computers, and related devices to connect and communicate with each other.

Hitting a wall

MidiWing is a small box containing circuitry with several inputs that connect to switches and sensors, such as a joystick, mouse, slider, or fader, that produce sound when moved. "You can plug in whatever control is appropriate to the person's physical condition," Daily says. "It sounds like any number of different instruments. The range of pitches can be narrowed or expanded, so the device can be made easier or more challenging as the person uses it and gets more familiar."

He started work on MidiWing in 2000, six years after moving to Taos and the same year he began teaching music in the town's public schools. The first prototype and pilot projects were completed in 2004.

Then Daily hit a wall. The microprocessor chip he used was discontinued and he didn't have the resources to find another for the next prototype. "I was in a bad situation," he says.

Daily turned to the New Mexico Small Business Assistance (NMSBA) program, which pairs entrepreneurs with scientists at Sandia and Los Alamos national laboratories. The state-funded program was established in 2000 by the New Mexico Legislature to help small businesses get technical support from the labs. It has provided \$29.8 million in assistance to 1,876 companies in 33 counties. The help is free of charge to the business.

Daily joined forces with Kent Pfeifer (1716), a Sandia microsystems engineer who coincidentally has a background in music. Kent plays trombone, piano, and banjo, and was in his high school marching band. "I do understand music," Kent says. "I know how scales should sound and how notes are produced."

Kent helped Daily build a new prototype that uses an advanced chip with more capability. "The idea was to build an instrument that has a whole bunch of different types of interfaces with the ability to run off a mouse, joystick, or other kind of device that can be configured to the abilities of somebody with a disability," Kent says. "You can play it with your mouth, your feet, or a single hand."

Daily says Kent took the concept and ran with it. "The implementation is all new," he says. "MidiWing has a lot more inputs and can be configured in a number of different ways. There are more ways to control the instrument."

An 'incredible collaboration'

Kent reprogrammed and modernized MidiWing with advanced microcontroller circuitry that made it smaller and more functional. "MidiWing works with the synthesizer software in a computer," he says. "A USB cable sends a series of hex commands built around the MIDI standard. The software in the computer interprets those and turns them into sounds."

MidiWing can calculate the many different frequencies or pitches that produce complex musical sounds from the position of the joystick or other input. The instrument simulates frequencies that are normally produced by the technique of the musician, for example by the pressure of a player's lips on a brass instrument.

Learn more about MidiWing at www.midiwing.com. View videos of people playing the instrument at <http://www.youtube.com/midiwing>.

"We know mathematically the frequency difference between note steps. We can write an equation," Kent says. "That's programmed into this."

MidiWing also has inputs that can subtract half steps, whole steps, and other intervals from the fundamental frequency. "Players press or activate the switches. It's similar to the keys on a trumpet. Three keys can hit a wide range of notes," Kent says. "What this does is calculate the resonant modes and the steps that are added by the keys. It keeps track of where the mouse or other input is. When you hit the button it calculates that information and sends the proper code in MIDI to the computer. The computer analyzes it, identifies the note and volume, and renders it."

Daily says Kent was more than just an adviser. "He was pivotal. It was an incredible collaboration because Kent is a musician," Daily says. "The key to the whole project was that he understood what I was trying to do from a musician's standpoint. He was perfect. He has a music background and designs microcontroller products. I can't imagine how it could have gone better."

Kent and Daily work together a few hours a month and are close to having an inexpensive product that can be manufactured and marketed to schools, hospitals, therapy and rehab centers, and other places where people want to make music. The final MidiWing is a hand-held, portable box that plugs into a computer, laptop, iPad, sound module, or other device with synthesizer software.

Opens a world of music

"I've tested MidiWing mostly with children and disabled people," says Daily, who founded a company, Musicode Innovations. "Children are perhaps the most successful. They are able to play far beyond what other music programs have ever produced. In a short amount of time they sound great."

MidiWing earlier this year was named one of 10 NMSBA projects that delivered outstanding innovations through the program during 2011. Some 340 small businesses participated last year.

Kent says there were big challenges in the project, particularly getting USB to recognize a MIDI device, but that it has been rewarding. "It's a really great idea," he says. "With a physical challenge it's almost impossible to play a musical instrument. If you remove the physical aspect, it opens the world of playing music to more people. With MidiWing you can make sophisticated sounds and even something that is quite lovely. If you can push a button or move a slider or mouse, you can get there. And we have worked hard to make it a professional instrument, not a toy."

Kent says he enjoys the MidiWing as a musician. "I come into the lab sometimes and just play it," he says. "Then I'll think, 'Ah, I can make a change,' and start programming. I want to make it even better."

Daily, who also teaches music at the University of New Mexico-Taos, says Kent shared his vision and desire to build an accessible and adaptable device that allows anyone to play music.

"My motivation is to bring music-making to more people," he says.

The New Mexico Small Business Assistance program is accepting applications for 2013 projects at its website, www.nmsbaprogram.org. Sandia researchers interested in helping a small business solve a technical challenge or problem can contact Genaro Montoya (1933) at gmontoy@sandia.gov or 505-284-0625.